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ABSTRACT

This study proposes to explore characteristics not usually considered musical, and yet which might combine in persons in such a way that results may lead to a clearer understanding and more accurate measurement and prediction of musical talent. Two hypotheses were tested: (1) Musical talent can be predicted by means of a selected set of variables postulated to represent "non-musical" measures of intellectual and psychomotor, personality, and sociocultural indicators; (2) There will be no statistically significant loss of predictive efficiency when regression weights assigned to the set of predictors from one community sample are applied to data from other communities. The criterion of being musical was based upon a student's belonging to none, one, or more of eight classifications of observed musical behavior. The sample population for this study was drawn from students in the Human Talent Research Program population who had just completed 12th grade in 1963. Statistically the results of the present investigation were modest. In describing differences among persons in a given sample on the basis of observed musical behavior, predictor models accounted for variances ranging from one-sixth to one-eighth. No results were obtained that supported the hypothesis that such models would retain their predictive efficiency when applied across samples. (CK)

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A STUDY TO EXPLORE NEW METHODS OF IDENTIFYING AND MEASURING MUSICAL TALENT

Cooperative Research Project No. S-069-65

Wendell L. Osborn

The University of Texas
Austin, Texas

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CHAPTER I

INTRODUCTION

For a number of years the writer has been acquainted with problems involving the evaluation of musical talent. Situations where appraisals have to be made range from judging musical competition, to selecting members for musical performing groups, to auditioning prospective college music majors, to many other circumstances requiring some comparable decision. Usually judgments of this sort are quick impressions dependent mainly upon the skill and professional know-how of the expert making them. There may be supplementary information available such as records of previous experience, biographical data, or scores on some kind of musical aptitude measure, but rarely is this information of sufficient scope or in such form that it can be of more than superficial value to the judge.

Sometimes a quick decision based on immediate impressions is appropriate. Under other conditions in which judgments have far-reaching effects upon the future of the individual involved, hasty evaluations may prove unfortunate. Some encouraging results have emerged from numerous attempts through several decades to measure such attributes as pitch and rhythmic discrimination, memory for melodic themes, preferences for one type of music over another, and others. These appear, however, to have only limited effectiveness in predicting future success in musical endeavors, at the present time.

One reason appears to be that some of these attributes, as discussed later, are subject to dramatic improvement by training. There is a likelihood that, in some cases, what is interpreted as low "aptitude" might mean instead merely limited previous experience. Another reason is that some so-called musical aptitudes are by no means restricted to the field of music in their usefulness. The Navy has adapted a well-known music pitch test for its use (Ford, 1944; Harris and Charney, 1950); elementary typing courses emphasive rhythmic patterns to improve speed and accuracy; and training in enemy plane recognition depended on sound as well as sight, at least prior to supersonic aircraft. A high score on a pitch discrimination measure might be interpreted to predict success in Naval submarine detection as accurately as in a musical career, unless some other cues were available to the tester. A need exists for some more comprehensive means of making long-range predictions about musical talent than now exists.

What about such things as motivation and perseverance? How about the particular way in which a student recognizes a problem, copes with it, and then reaches a solution? And might there be some underlying attitudes or sets of values which would enable one person to communicate more successfully than someone else in this abstract "universal language"? Ultimate success as a concert artist or composer probably depends at least partly on how the individual functions in ways such as these. The present study explores some of these possibilities. By way of orientation, the remainder of this chapter is devoted to a brief discussion of the nature of music and the nature of musical talent.

The Nature of Music

What music is and how it affects people appears to be singularly resistant to analysis. Through recorded history and before, it has been an ingredient in a wide variety of rites, functions, and circumstances in virtually every organized society of which there is any knowledge. With a little thought, one could list a number of uses or functions commonly ascribed to music today. These might include the relaxing and digestion-aiding qualities of background music in a sedate restaurant; the stirring of patriotic ardor by a military band, or somewhat similar feelings toward alma mater by the school song played at a football game; the tension induced by mood music during a psychological or horror movie; the aid to romance of sweet music accompanied by soft lights; and many other types of situations in which music supposedly determines to some degree the behavior of persons involved.

Yet scholars agree that what is highly significant music to a particular group may have little or no meaning to another. That is, there is no evidence that music has universal characteristics which affect all persons equally or in the same way. For example, music in Western culture is based upon a tradition evolving from at least as far back as Pythagoras (c. 550 B. C.). The octave is divided into 12 approximately equal so-called "half" steps or intervals. Selecting from these 12 various series of seven "half" steps and "whole" steps forms the "diatonic" scale upon which the major portion of European and American music for a number of centuries has depended. From time to time small changes have been made in exact size (number of vibrations) of some of these 12 steps. Many theorists, theologians, and others through history have attempted to forestall any changes at various stages of this evolution, ascribing "natural" and at times "God-given" characteristics to their specific selected 12 intervals. And yet the Hindus have an octave scale composed of 22 tones, which can be sung with considerable accuracy; the Siamese are said to divide the octave into seven equal steps, and the Javanese into five equal steps (Farnsworth, 1958, pp. 22-31). Quite obviously music based on any one of these scales would communicate little to persons familiar only with one of the others.

Research in aesthetics, beauty, and artistic taste bears out the adage that beauty lies in the eye of the beholder. Each culture or sub-culture tends to develop its own system of values in music as in other activities; these may vary greatly from values held by other peoples, as for example Oriental music as compared with Western (Farnsworth, 1950, pp. 22-23). Also, groups within a culture may be similar in certain tastes, but different from other groups within the same culture. Thus, in America there is marked agreement in similar groups on composers who may be called "eminent" or highly talented; there is also close similarity among musical selections chosen by various disc jockeys (Farnsworth, 1950, pp. 7-14). And yet the symphony lover and the teenager may find almost no common grouns for musical communication.

A composition is beautiful or excellent according to a set of criteria established by a particular group at a given time; these judgments are superimposed qualities "with which an observer, according to his system of values, endows an object" (Mueller, 1951, p. 403). "Any object can be beautiful if it elicits a response of the organism which by its very characteristics may be labeled aesthetic" (Lundin, 1953, p. 170). "The beautiful characteristic . . . is not typically idiosyncratic . . . . Rather, it has the same significance for more than one person" (Lundin, 1953, p. 171).

As a culture develops certain systems of values, behavior which is directed toward attaining these values is approved and attains a crude stability (Ferguson, 1956). Presumably, children reared in different environments, which demand different types of learning at different ages, develop different patterns of ability largely in relation to the values set upon these types of behaviors by the culture. Differences in ability among persons due to environmental factors become even more pronounced in real life because of the interaction of these factors with unique biological propensities of the various individuals (Ferguson, 1954). For example,

> It is recognized that successful performance on certain wind instruments is facilitated by certain lip and mouth structure, piano playing by shape and size of the hands, and singing by the structure of the vocal cords. These physical structures are inherited, but no psychic "gifts" or "powers" are. Musical success is a function of many factors, always provided that one has a sound biological equipment. These may include the particular stimuli with which one comes in contact -- musical ones. The contact may be rather incidental, both at the beginning and later, or quite deliberate. Other musical surroundings and the attitude of parents and friends toward music are important (Lundin, 1953, p. 9).

Much of the difficulty attending the scientific study of music may be accounted for in one of three ways. First, actual music in performance is confined to a particular time and place. Archeologists have been able to reconstruct various art modes of former cultures on the basis of remains of sculpture, drawings, buildings, and similar means. But the music which was also undoubtedly part of these cultures died moments after the sounds were produced. Even the same person or a group will not perform a composition exactly the same on successive occasions.

A painting may be glanced at hurriedly or examined carefully over a long period of time; a half-hour musical composition requires a half-hour of the listener's time, whether the listener be casual or intent. Radio, movies, and recordings have overcome some of the momentary quality of selected programs, but these represent such an infinitesimal part of the total amount of music performed that they can hardly be considered representative.

Second, many competent musicians believe that music cannot undergo objective analysis of any scientific nature without destroying much of the inherent aesthetic value. Studios which produce leading musical performers are sometimes so highly individualized that it is not unusual to find that frequently-used terms cannot be defined by one musician to the satisfaction of another. This resistance to even a common vocabulary makes an organized scrutiny of psychological aspects of music difficult at best.

Third, scientific studies involving music and sounds have produced a wide range of results and theories, due to the complexity of the musical phenomenon itself. Lundin illustrates this by the following example. Using sound as a stimulus, the musician refers to three of its characteristics as pitch, loudness, and timbre or tone quality, while the physicist refers to approximately the same elements as frequency, intensity, and wave form, respectively. Although similar, these three pairs of terms are by no means synonymous, and cannot be used interchangeably. The musician (and in many cases the psychologist) is concerned with tonal aspects, and the physicist with vibrational aspects of the stimulus sound. Thus, two sound stimuli may be of the same frequency, and yet may be identified as being different pitches, because of the differences in intensity, wave form, or other intervening factors (Lundin, 1953, pp. 12-31).

A few selected studies may suffice to indicate the diverse types of results sought by investigators in specialized fields, all of which involve music and people in one way or another.

Does the playing of music in an establishment affect the behavior of a customer or client? Many businesses believe that it does, and are willing to pay for this service. Best known commercial use of music is that by the ubiquitous "Music by Muzak", which sends prepared programs of music by wire into restaurants, offices, and various other types of businesses throughout the country. Results of research by the Muzak Corporation into the effects of music on different types of clients are shown in a wide variety of available "custom made" programs which are based on geographical location, age, sex, education, and occupation of the intended listener (Cardinell, 1948, pp. 352-366).

Did Walt Disney have any scientific basis for having the seven dwarfs sing "Whistle While You Work" in his movie? Perhaps not intentionally. However, reminiscent of one function of the "work song" of the Volga boatman and the Negro slave, industrial studies indicate that music played intermittently increases output in repetitive tasks (Smith, 1947; Wyatt and Langdon, 1937a, 1937b), as well as reducing fatigue, worry, and tension under various work conditions (Kerr, 1942, 1944, 1945; Kirkpatrick, 1943; Reynolds, 1943; Spears, 1947).

How does the organism itself react to sound stimuli? Do dramatic differences in conditions of the organism affect its responses? A wide range of results has emerged from intensive study of such questions by physiologists and others, but for the purposes of the present investigation two or three examples may suffice. Using the psychogalvanic reflex, or galvanic skin response (GSR) to measure bodily changes, musical excerpts judged to be exciting or gay, and others judged as sad or calming, were played. Exciting music produced a decrease in electrical skin resistance, while calming music produced an increase. Children tended to have a greater magnitude and a shorter latency of response than either college students or psychotics (Phares, 1934; Zimny and Weidenfeller, 1962). There seems to be a direct correspondence between the degrees of galvanic change and the importance of music in the subject's life (Dreher, 1947). Following administration of special music rhythm tests to 25 cerebral palsied children, the conclusion was reached that such children can explore only limited areas of rhythmic expression. Intelligence does not seem to be a determining factor, but perseveration does (Sato, 1962). Some persons are so affected by music that listening to certain kinds of music leads to epileptic attacks (Critchley, 1942). Within the music therapy profession a large body of comparable data has been gathered (Gilliland, 1962).

What does the listener hear? Under some conditions persons tend to organize sound patterns in such ways that these have meaning for them, regardless of what the original stimulus patterns might have been. At least some of the reorganization of patterns can be accounted for by what the listener has learned to expect from his past musical experience. The individual tends to "hear" what he wants to hear, or what the investigator intends for him to hear, which might be somewhat different from what was actually presented (Bloomsliter and Crell, 1962; Meyer, 1962a, 1962b; Seashore, 1938, p. 29; Ward, 1962).

Studies into the process of musical creation vary from subjective reports which describe the "meteors of sound that leap through the mind like volcanic fire, in a glory and fullness unimaginable except to those who have heard then" (Cowell, 1926), to those concerned with statistically significant relationships between abstract art designs presented as stimuli and resulting musical compositions by "standard" and "popular" composers (Willmann, 1944).

The preceding sampling of areas of musical investigation indicates some of the diversity of interest and results, which in many cases cannot be used to advantage interchangeably. It also suggests the absence of a single, underlying notion as to the nature of the musical phenomenon.

Music may be considered to be a product of the culture within which it exists, and, in its own way, a reflection of that culture. Atomistic concepts and isolated investigations can add little to overall understanding, unless they can be related to other concepts and studies which may as legitimately be considered musical. Certainly "music" is more than the total of combinations of tones and rhythms, and musical talent is more than the total of sensory perceptions (Mursell, 1937a, pp. 300-323).

The Nature of Musical Talent

A general definition of talent used by McGuire and associates may be applied to some particular areas without undue misrepresentation. Thus, musical talent may be defined as a pre-eminent aptitude or superior ability in the field of music, either natural or acquired, or a capacity for achievement or success in musical endeavors. Talented musical behavior involves both personally significant and socially-valued competencies, recognized as such through performances or products which can be assessed by other persons (McGuire and Associates, 1960, p. 1). Accordingly, a person may be designated as being musically talented on the basis of singing a song, composing a tune, or by achieving a certain score on a measure of pitch discrimination or rhythm. Obviously, in making an evaluation on the basis of a sample of musical behavior, the more specific or limited the sample, the less accurate the judgment of the person's total musical talent is likely to be.

A question which has aroused controversy for years is whether musical talent is an innate, pre-determined capacity in persons, or instead a characteristic which can be acquired or improved with training. Although the definition of musical talent above indicates that such a distinction is not a primary focus of the present study, it nevertheless has bearing on it.

The importance of such a question lies partly in the persistence and popularity of the outmoded notion that this characteristic is absolutely unchangeable. From this point of view, an instrument which measures certain fundamental musical characteristics will furnish a permanent index of an individual's total potential in this field, regardless of the point in life and experience at which it is administered (Seashore, 1919, p. 169; Schoen, 1940, pp. 161-163). Of equal importance in this question is the role of the music educator from such a viewpoint: "All that the teacher can do is to provide the right conditions for the development of the child's inborn powers" (Wing, 1963). The most ardent and published advocate of the innate musical talent theory states that pitch is a fundamental capacity upon which most of the talent rests (Seashore, 1919, p. 42), and that "fortunes have been spent, and thousands of young lives made wretched by the application of the theory that the sense of pitch can be improved with training. It is the cause of the outstanding tragedy in musical education" (Seashore, 1938, p. 58).

The present writer holds, with others, that to some extent, at least, "talented *behavior* is acquired and becomes organized, or structured, and to some extent predictable *as a consequence* of the educative process" (McGuire and associates, 1960, p. 1. Italics added).

The "once and for all" solution to musical talent measurement, and particularly pitch, provides a convenient tool for quick decisions in large scale selection, and furnishes a handy, though questionable, tone of authority to the persons using measures interpreted in this way. On the other hand, if certain fundamental characteristics of musical talent are such that they may be improved by training, then a different type of instrument, or a different approach to measurement and interpretation, or both, is desirable.

The present study proposes to explore characteristics not usually considered musical, and yet which might combine in persons in such a way that results may lead to a clearer understanding and more accurate measurement and prediction of musical talent. A fundamental difference between conventional approaches and the present one lies in the latter's emphasis on what might generally be called "temperament"; that is, the combination of those attitudes, personality factors, and other attributes which show promise of distinguishing musical persons from others, quite aside from their capacities in areas such as auditory discriminations of one kind or another. The two viewpoints are not antithetical, but rather may be thought of as complementing one another in the investigation of musical talent.

The Scope of This Study

The present study is concerned with identifying and measuring relationships between a criterion of observed musical behavior and variables postulated to represent cognitive, personality, and socio-cultural characteristics in persons. As explained in Chapter II, this socially defined musical talent can be evaluated with the assistance of McGuire's context theory of human behavior using multiple regression techniques to provide the probable answers to questions; namely,

1. Do operationally defined measures of each of the categories of cultural-context theory yield some independent contribution to the prediction of musical talent in the present of measures representing each of the other theoretical categories?

2. Can a relatively potent subset of indicator variables be selected which would appear to be useful in such real-life situations as evaluating potential college music majors, or in selecting children who might profit from musical training?

3. How valid is such a set of indicators? That is, how much predictive efficiency is retained when regression information obtained from one sample of subjects is used in making evaluations regarding other samples of subjects?

The above questions are investigated by employing two kinds of criteria; namely,

1. By an operationally defined dichotomous "musical versus non-musical" criterion classification of subjects.

2. By a scaled criterion of musicality based on the number of different operationally defined categories of observed musical behavior to which the subject belongs.

CHAPTER II

THEORY AND DESIGN OF RESEARCH

The present investigation is predicated on the belief that "talents" are culturally defined characteristics in persons. Given sound biological equipment and certain propensities which would enhance a particular kind of endeavor, then talents emerge in response to values set up by the culture itself. A sensitivity to pitch is equally valued in a violinist and certain Naval specialists; highly developed rhythmic coordination is necessary to being successful in music, and as a telegraph operator, ballet dancer, and typist. The techniques and personality necessary for successful stage performance are valued in the singer, the dramatic actor, and perhaps almost as much in the politician. Thus it is the combination of characteristics in certain ways which provide the cues to predicting successful behaviors in the various fields (Kaplan, 1964, pp. 325-326).

A theoretical model has been developed which is well suited to evaluate such complex relationships. According to this model, a particular observed behavior such as musical talent may be considered to be a function of the way in which an individual's cognitive, perceptual, and motor processes operate, as well as attributes which may be considered to be aspects of one's personality such as motivations and inhibitions and the way in which the individual regards himself. Moreover, pressures and expectations which other persons impose on him, as well as the socio-cultural structuring within which the observed behavior takes place, may provide certain opportunities or impose certain limitations upon the individual. Within this theoretical model not only is a direct relationship hypothesized between such independent variable and a criterion of observed musical behavior; in addition, the predictive value of each variable is assumed to be influenced by the presence of the other independent variables within the set.

A quasi-mathematical formulation of this model is as follows (McGuire and associates, 1960; Spector, 1963; Whiteside, 1964):

$$\text{Observed musical behavior} = f\ (P, E, R, C)$$

where P = potential abilities of the individual as these might enhance or impose limitations on musical learning or performance; particularly cognitive, personality, and motor functioning;

E = elements of personality of the individual such as motivation and expectations about himself and others which might affect musical learning or performance;

R = response of other persons toward or concerning the individual including expectations and pressures they impose upon him, which may be conducive or antagonistic to development of musical talent;

C = cultural context within which the behavior takes place such as the school and community socio-cultural structuring, which may or may not provide a suitable "climate" for development of musical talent.

The criterion "observed musical behavior" is defined operationally by means of eight different types of recorded musical performances which are postulated to represent various socially-valued musical competencies. The decision to use the eight categories is based upon three assumptions:

1. "Musical talent" as used in this investigation is considered to be at least partly culturally defined. Membership in each of the eight categories of being musical is determined largely as a result of evaluation by representative segments of the culture. These cultural representatives range from trained musical experts such as band and choral directors and other professional music judges to groups composed of peers and other non-professional persons who nevertheless may be considered typical of the culture.

2. Individuals classified in any of the criterion musical groups employed in this study are assumed to possess at least minimum auditory discrimination as measured by conventional "musical talent" instruments. The assumption would appear to be valid since membership in these types of groups corresponds to criteria of being musical used in validating frequently used measures (Brennan, 1926; Drake, 1933, 1954; Lawske and Wood, 1947; Mursell, 1937b; Stanton, 1935).

3. The amount of musical talent an individual possesses may be assumed to be a function of the number of different ways in which being musical is manifested. In other words, the more musically talented a person is, the greater the probability that he will belong to the school band or choir, will be engaged in musical activities outside of school, will be considered to be musical by classmates and/or teachers, and/or will have won state or national music awards.

Related Literature

The psychological study of musical talent came of age with the publishing of The Psychology of Musical Talent (Seashore, 1919), and its companion Seashore Measures of Musical Talent. A general approach to the scientific investigation of both music and musical talent, or aptitude, was set forth which has had considerable influence on subsequent research and theorizing. Although the present study is based on a rather different way of looking at the musical phenomenon, certain of the concepts upon which Seashore and others have based their work have been cited in order that a comparison may be made between contrasting frames of reference which have important educational and theoretical implications. Literature relating to this investigation has been organized within four general areas, which together form a background for the present research.

"Non-Musical" Components of Musical Talent

Intelligence, personality, attitudes, family and home environment, and other factors are considered by most writers to contribute in one way or another to the general behavior characterized as musical (Farnsworth, 1958, p. 248; Lundin, 1953, p. 9; Mainwaring, 1947; Mursell, 1937a, pp. 322-323; Pratt, 1931, p. 61; Revesz, 1954, pp. 131-133; Schoen, 1940, p. 162; Seashore, 1938, pp. 304, 314, 339-341). Practical means have been slow to develop for measuring this diversity of attributes as they might relate collectively to musical behavior; much of

Seashore, 1938), current psychological opinion is that in many ways musical behavior is "subject to the same kind of conditions as any other types of psychological action" (Lundin, 1953, p. 9). That is, successful achievement depends to some extent upon such things as a "drive or urge toward music" (Seashore, 1938, p. 2), or motivation. Such skills and attributes as the ability to learn, to remember, and to perceive constitute a large part of what is called musical behavior (Lundin, 1953, p. 10; Seashore, 1938, p. 340).

The importance of sensory acuity cannot properly be disregarded; this, however, represents but one aspect of the total consideration of musical ability (Seashore, 1938, pp. 293-294), which probably does not depend simply on the action of single organs such as the ear. It involves "integrating, selecting, interpreting action of the central nervous system" (Mursell, 1937, p. 76), and other psychological properties of experience which are not in the domain of physiological processes (Lundin, 1953, p. 9; Mull, 1925; Neu, 1947; Pratt, 1931, p. 61). Musical achievement depends upon the relationship of various capacities to each other; "inferior and medium capacities in some factor may constitute adequate support for excellence in some dominant capacity" (Seashore, 1938, p. 335). Kaplan affirms the value of a comprehensive approach to understanding such types of problems in the behavioral sciences by stating,

> In the present state of our knowledge, human behavior is often seen as the outcome of the joint working of a number of distinct and often unrelated factors, as in the choice of a mate, or in the outbreak of war between nations. Consequently, two-variable causal laws are often inadequate. . . . We need to know, not only the separate factors that are determinative of behavior, but also how they interact with one another (Kaplan, 1964, pp. 325-326).

Innate versus Learned Musical Attributes

The definition of musical talent in Chapter I makes no issue as to the source of this characteristic in persons. Some importance is attached within the overall orientation of the present study, however, to the likelihood that some aspects of this talent are subject to change due to cultural pressures and influences (Farnsworth, 1958, p. 13; Lundin and Allen, 1962; Mull, 1925; Neu, 1947, 1948). These same aspects are among those considered by some others to be inborn and unaffected by training or learning (Schoen, 1940, pp. 161, 168; Seashore, 1919, pp. 15, 59, 169, 1938, p. 58; Wing, 1963).

If, for example, the degree to which an individual is able to discriminate between different pitches is accepted as an index of his musical talent (Seashore, 1939), and at the same time the investigator believes that this measured attribute cannot under any conditions be changed or improved by training or experience (Schoen, 1940, pp. 161-163; Seashore, 1919, p. 42; Wing, 1963), then at any age level a decision may be made on the basis of measuring this attribute, and "all that the teacher can do is to provide the right conditions for the development of the child's inborn powers" (Wing, 1963). This is in fact the sort of decision sometimes made in the primary grades, where those children who can sing on pitch are called "Bluebirds", and the non-singers "Blackbirds", or similar titles. In such a situation musical instruction is directed toward the "Bluebirds", while the "Blackbirds" are guided into some other type of activity. If the "innate" point of view expressed just above is not a valid one, then perhaps many of the "Blackbirds" are being denied the very basic experience which would enable them to profit from subsequent musical training.

To pursue the discussion of pitch a step further, a substantial portion of the arguments put forth by hereditarians focuses on the phenomenon of so-called absolute, or "perfect" pitch. Definitions vary, but in general these agree that absolute pitch is the ability to name any sounded pitch without the aid of a reference tone (Bachem, 1948; Neu, 1947, 1948; Revesz, 1954, pp. 95-98).

Proponents of the "innate" theory in general consider absolute pitch to be just what the term implies, namely, an all-or-nothing absolute. Nevertheless, there is an elusive quality about such categorizations as universal genuine absolute pitch and limited absolute pitch (Revesz, 1954, p. 96), and absolute pitch, quasi-absolute pitch, and pseudo-absolute pitch (Bachem, 1948). Seashore, probably the most ardent proponent of this theory, states with like equivocation that "it is convenient to make the distinction that absolute pitch may be thought of as involving accuracy to a very small fraction of a semitone; whereas acquired pitch is usually thought of in no finer terms than semitones" (Seashore, 1940). These and other unabsolute categorizations are at best very tenuous bases to use for substantiating the claim that such an ability is innate, and that the sense of pitch positively cannot be improved with training (Bachem, 1948; Mainwaring, 1947; Revesz, 1954, pp. 95-98, 136; Schoen, 1940, p. 161; Seashore, 1919, pp. 15, 59, 169, 1938, p. 58; Wing, 1954). This is more especially the case in light of investigations such as those cited below.

In his review of literature dealing with pitch, Neu concludes that "the ability to discriminate pitch is acquired in a person's life-time, and . . . accuracy in hearing a pitch as a certain note depends upon his own reactional biography" (Neu, 1947). This conclusion is based upon, or reaffirmed by, a number of studies in which measured improvement appears to result from guided practice or learning (Jersild, 1932; Jersild and Bienstock, 1934; Lundin and Allen, 1962; Mull, 1925; Neu, 1947, 1948; Repina, 1961a, 1961b; Wolner and Pyle, 1933; Wyatt, 1945). Pitch-discriminating ability does change under such controlled conditions; current educational and psychological experimental research generally favors a "learning" interpretation, rather than ascribing subsequent changes to providing the right conditions for developing abstract inborn powers (Wing, 1963), or attributing original lower scores to undefined distraction and ignorance (Seashore, 1919, p. 51), or unmeasured lack of understanding of test requirements, mental development, good will, or general power of application on the part of the subject tested (Seashore, 1938, p. 57).

For example, in one study of pitch training, "average" persons were trained to a degree of pitch discrimination comparable to Seashore's criterion for absolute pitch cited above (Mull, 1925). In a striking example of pitch training, seven children were selected as subjects because they were so markedly deficient in pitch discrimination that they were incapable of distinguishing piano intervals as large as an octave. After an intensive 81-day pitch-training period, all seven could identify pitch differences to a small fraction of a semitone. The standard of perfection was 10 out of 10 trials correct (Wolnar and Pyle, 1933). Other investigations furnish additional evidence of the improvability of pitch discrimination and sensitivity in singing, in groups ranging from very small children to adults (Jersild, 1932;

Jersild and Bienstock, 1934); in training designed to reach a criterion of absolute pitch (Lundin and Allen, 1962); and in Russian "musical game" experiments involving small children which "refute Seashore's bourgeois theory" of inherited, unimprovable pitch acuity (Repina, 1961a, 1961b). In her critical review of Seashore's publications Wyatt concludes that these furnish little if any scientific evidence that under propitious conditions and training, a person's sensitivity to pitch cannot be improved (Wyatt, 1945). That is to say, although the biological equipment with which a person is endowed at birth is very important (Lundin, 1953, pp. 9, 189), the degree to which he may be considered to be musically talented depends to a considerable degree upon action of the entire central nervous system (Mursell, 1937a, p. 76), as well as the nature of his experiences within a particular socio-cultural orientation (Lundin, 1953, p. 9; Pratt, 1931, p. 61).

Farnsworth sums up major current findings by stating, "A person's abilities will mature only if the social climate is propitious. They can be expressed only in the context of man's own and his culture's taste, and this taste may prove stimulating or inhibitory" (Farnsworth, 1958, p. 13; Faris, 1961). That is, relatively stable characteristics or patterns of behavior (e.g., "talents") develop generally throughout a culture or segment of it to the degree that these are valued by that culture. People practice and acquire skill in behaving in ways that gain the approval of someone (Ferguson, 1956).

At the present time preadolescent formal music education is at best a spotty thing (Farnsworth, 1958, p. 231). Some elementary schools have no musical program within their curriculum, and others only fragmentary ones. This may be interpreted as being indicative of the relative importance of music within the educational requirements set up by the community. Types of behavior (or skills, or knowledge) which are not "important" to a large number of the group, or which become important only in adolescent or adult life, will have little likelihood of attaining any stability prior to this time. Under such conditions earlier measurements of these patterns of behavior would be difficult and doubtless unsatisfactory. That is to say, on the assumption that certain "musical" talents (e.g., pitch and rhythm skills) are acquired over a period of time, then scores on measures of these perhaps indicate previous experience as much as they do future potential.

Other characteristics in persons may be considered to have reached a measurable stability by this time. Certain facets of personality, for example, have been described in terms of persistent patterns of behavior, attributes, and qualities, or concepts of one's self that differentiate one from another (McGuire, 1960). Intelligence, achievement, attitudes, and other attributes, at least within the educational milieu, reach a measurable consistency relatively early in the school experience (Farnsworth, 1958, p. 248; McGuire and associates, 1960, p. 1).

Interestingly, although in general the actual instruments designed to measure musical talent are limited to auditory testing of various kinds, most authors express the theoretical belief that these are only part of this talent (Lundin, 1953, pp. 203ff.; Mursell, 1939).

Currently-used Musical Talent Measures

A multitude of tests have been devised for measuring various kinds and levels of musical ability. Almost universal is the audition, by choral, orchestral, and band directors, private music teachers, concert agents, and others, in which a brief informal performance is evaluated subjectively in terms of what the listener desires or needs. Sometimes this is formalized into a "quickie" such as the three-minute test by Wing (1957), and various short unvalidated tests put out by instrument manufacturers and others for some sort of preliminary decision-making.

Other measures represent a more organized approach to evaluation of musical aptitude or talent. Instruments introduced by Seashore in 1919, for example, are accompanied by a highly developed theory as to the nature of musical talent, and have been revised periodically by their makers.

No consistent pattern has emerged for testing the efficiency of musical aptitude measures. With one notable exception no single extensive long-term validation study has been made which involved the use of such measures. This exception is the Eastman Experiment (Stanton, 1935).

Over a 10-year period Helen Stanton administered five of the Seashore Measures to all students entering Eastman School of Music. These measures were subtests of the 1919 version (Seashore, 1919), and included Pitch, Intensity, Time, Tonal Memory, and Consonance. Reliability on these, by split-half and retest, ranged from .45 to .90. Combining scores on these five measures with those of an intelligence test, a test of tonal imagery, and a case history, she divided each entering class into five prediction categories ranging from "discouraged" to "safe". Using graduation as a criterion for success, results showed 17 per cent of the "discouraged" group graduated; 32 per cent of the "doubtful" group; 33 per cent of the "possible"; 42 per cent of the "probable" group; and 60 per cent of the "safe" group.

In evaluating Stanton's "Eastman Experiment", two comments are appropriate. First, the Seashore Measures were used in combination with other data, and no correlation or indications of weightings of these is given. Very possibly the same types of results or even better ones could have been achieved by using merely the intelligence test and the audition (Mursell, 1937a, pp. 297-298). This possibility is indicated by studies which do show intelligence test scores to have a slight superiority over the Seashore Measures in predicting performance success in music (Highsmith, 1929; More, 1932). Second, few would question the viewpoint that acceptance in Eastman School of Music in itself is a strong indication that the applicant has demonstrated above average musical "aptitude", doubtless including experience and performing skill, before applying. The Stanton battery then becomes a measure of which of these musically inclined persons can profit most from the particular organization of musical education in this institution. Such an evaluative instrument is highly desirable, but cannot necessarily be considered to be a measure of who has potential talent and who does not.

The 1919 version of the Seashore Measures of Musical Talent consists of six subtests postulated to measure pitch, intensity, time, consonance, rhythm, and tonal memory. The 1939 revision (which changed the "Talent" to "Talents") changed the second subtest from "intensity" to "loudness", and the fourth from "consonance" to "timbre".

Seashore uses the Eastman experiment to substantiate his claim that pitch is unimprovable (Stanton, 1935, p. 10); at the same time he condemns the use of exactly this type of omnibus musical behavior "including such diverse and unrelated situations as composition, directing, voice, piano" and others for validating his measures (Seashore, 1937). Seashore asserts that each of his measures has well established internal validity; for example, pitch has been isolated from all other factors, and the pitch test measures pitch (Seashore, 1939). Only in the theoretical exposition, then, the importance of pitch as one talent in music is argued (Seashore, 1938, pp. 304, 314).

Considering music to be essentially a socio-cultural phenomenon, one would conclude that such diverse situations as voice, piano, composing, conducting, music theory, and similar behaviors do in fact constitute a large measure of what musical behavior is in our time, and therefore are the only satisfactory method of validating such measures (Mursell, 1937b). Disregarding their author's remonstrances, a number of investigators have validated the 1919 version of the Seashore Measures of Musical Talent against such criteria as teachers' ratings on performance, and a variety of grades in music courses. Eleven such validation studies are presented in table form by Lundin (1953, p. 208). These show coefficients ranging from -.27 to .80; 42 out of a total of 91 coefficients are .15 or below.

Lundin (1944; 1949) constructed a set of five tests designed to measure kinds of musical behavior not investigated by his predecessors. The tests are interval discrimination, melodic transposition, mode discrimination, melodic sequences, and rhythmic sequences. Split-half reliability coefficients range from .60 to .89 computed for musical and unselected groups on each of the five tests and also on total scores, with the exception of a coefficient of .10 for the unselected group on mode discrimination. Validated against six specific behavior ratings made up by music professors, the musical group total score coefficients ranged from .43 to .70.

Drake (1933) published a four-test measure of musical talent in 1933, consisting of musical memory, interval discrimination, retentivity, and intuition. Initial reliability data ranged from .43 to .93, while validity coefficients were reported from .35 to .67. In a revised version he replaced these with a set of two tests. They are musical memory, and rhythmic ability. Each test has two forms. Persons with five years or more of musical training take only one form of each test, while musically untrained persons are to take all four forms (Drake, 1954). Reliabilities are reported in the high .80's and the low .90's, and correlations against teacher estimates of talent have run as high as .91. (Farnsworth, 1958, p. 244). Both the Lundin and Drake Tests appear to be tapping some aspects of musical characteristics; however, neither has gained the extensive use or popularity of the Seashore Measures.

Kwalwasser, alone and in collaboration with other individuals, has constructed a number of tests ranging from musical talent to musical taste, of various lengths, types, and difficulties. Best known of these is the Kwalwasser-Dykema Music Tests (1930). The Kwalwasser-

Dykema measures consist of six subtests which are similar in name to the Seashore 1939 measures, plus four additional subtests: tonal movement, melodic taste, pitch imagery, and rhythmic imagery.

Lundin furnishes a table of reliability coefficients for the Kwalwasser-Dykema tests reported by six investigators. These range from -.10 to .85 on various of the ten subtests, but only two these subtests show any coefficient over .66 (Lundin, 1953, p. 212). Five validation studies using criteria such as grades in sight singing, theory, dictation, and performance show no coefficient as high as .60 for any of the tests, and more than half lie between .15 and -.18 (Lundin, 1953, p. 213). A more recent Kwalwasser Music Talent Test (1953) is published commercially without reliability data of any kind, and constructed on the premise that scores on these measures are not affected by musical training (Farnsworth, 1958, pp. 242-243).

The above measures are representative of the most commonly used published instruments for assessing musical talent. Together they touch on a wide variety of aspects which are related to sound. Certainly this is the most important consideration as far as the end product is concerned, namely, music. From the standpoint of being musical, however, a large quantity of variance is unaccounted for by each of the measures described.

Multivariable Analysis

The advent of the high speed electronic computer has made practical the processing of amounts of data and the use of procedures which previous to this were largely impossible. What until recently were only conjectures have now in many cases become testable hypotheses by means of sophisticated programing designed specifically for computer analysis.

Some of the "non-musical" attributes of talented musical behavior hypothesized by psychologists have been listed earlier in this chapter. At the present time, assessment of persons by measures representing each of these attributes separately constitutes a formidable task. A common practice today even at the college level is to use few, if any, of such measures as a means of predicting musical success, in spite of strong theoretical evidence as to their probable contribution to it. Undoubtedly a major reason for this is the lack of suitable instruments which can be easily administered and scored, as well as the absence of any means for judging the relative importance of each attribute to the total judgment.

At the present time exploration into multivariable methodology has reached a level which allows an optimistic view regarding its application to such a complex problem as assessing attributes of the type under consideration. So far little has been done which would offer guidelines specifically within the field of music, but studies dealing with correlates of various talented behaviors furnish promising possibilities.

The Human Talent Research Project itself demonstrates the scope which explorations can encompass, not only in numbers of subjects involved but also in the variety of ways in which relationships, causes, and predictions can be investigated by multivariable approaches (Mc-

Guire and associates, 1960).

Factor structures evolving from these analyses describe several postulated underlying dimensions in persons which afford a much more understandable and manageable tool than the large number of separate measures themselves. Among these are such factors as convergent thinking and divergent thinking, which appear to bear out some of Guilford's concepts regarding structure of the intellect (Guilford, 1956). Other factors which emerged were composed of personality variables, and variables postulated to represent environmental and sociocultural relationships. Taken together, these factors constitute a theoretical structure which appears to provide a satisfactory frame of reference for describing and predicting various kinds of behavior on the basis of underlying dimensions of both intrapersonal and interpersonal behavior. The practical research value of such a structure is borne out by several studies dealing with such areas as adolescent behavior (Hindsman, 1960), adolescent deviant male behavior (Kelly, 1963), adolescent creativity (Spector, 1963), academic achievement (Whiteside, 1964), and predictions of teacher evaluations of students in secondary schools (Whiteside and Murphy, 1963).

For the most part these studies have used applied multiple linear regression models (Bottenberg and Ward, 1963) to investigate such a contextual theory of behavior. They provide a mathematical representation of relationships between criterion and predictors, plus an indication of the independent contribution of each; in addition, these models assign weights to predictor scores in such a way that these may then be applied to data from new populations. The problem of generalizing from one population to another has been studied and methods for determining whether or not this may be justified have been set forth in studies on cross validation procedures (Jennings, 1963; Ward, 1953; Whiteside, 1964).

Investigations seeking additional means of utilizing linear regression techniques include a description of various specific types of applications which can be applied particularly to behavioral sciences research (Bottenberg and Ward, 1963). Also considerably refined means for selecting a potent set of predictors from a much larger number of independent variables have been demonstrated, which appear to incur little loss of predictive efficiency (Schultz and Goggans, 1961).

In summary, although existing musical talent measures have some validity, they appear to be tapping only a portion of the underlying factors involved. While these are limited mainly to auditory tests, the theories out of which they have developed include a number of "non-musical" attributes such as personality and intelligence as being discriminating variables which may contribute to a person's being successful or unsuccessful in the field of music. Recently complex theoretical formulations have come within the realm of practical testing with the advent of the high-speed electronic computer and its accompanying technical analytical innovations.

Hypotheses

The objectives of this study may be expressed by the following hypotheses, which are to be tested by multiple linear regression techniques:

(1) Musical talent can be predicted by means of a selected set of variables postulated to represent "non-musical" measures of intellectual and psychomotor, personality, and sociocultural indicators. Such predictions can be made both on the basis of

- a. a dichotomous "musical" vs. "non-musical" criterion, and
- b. a "degree of musicality" criterion, which is equal to the total of the weighted scores representing the number of categories of being musical to which any person belongs.

(2) There will be no statistically significant loss of predictive efficiency when regression weights assigned to the set of predictors from one community sample are applied to data from other communities.

CHAPTER III

PROCEDURES

In 1957 a research team from The University of Texas began a six-year Human Talent Research Program (HTRP) based on public school students in Texas (McGuire and associates, 1960, 1961, 1966a, 1966b). The population for this study consisted of all students enrolled in the seventh grade in four Texas communities in 1957 who subsequently graduated from high schools in these communities in 1963, as well as those other students who were members of this progressing class at any time during the six-year study. Several hundred measures and data-gathering instruments of various kinds were administered to or collected about the more than 2000 students involved at one time or another as subjects. Each of these instruments was selected and used because of its possible relevance in assessing, understanding, and/or forecasting behaviors of various kinds within an educational setting. Although no conventional music aptitude tests were included in this battery, several instruments provide information which relates directly to musicality. The present study depends in part upon such data.

Criteria of Musicality

The criterion of being musical was based upon a student's belonging to none, one, or more of eight classifications of observed musical behavior. Any student belonging to one or more of these eight categories was designated as "musical"; all other students were designated as "non-musical". The categories of being musical are:

Category Number	Description of Observed Musical Behavior
I	Received a first-place rating in a state music contest.
II	Received one of the highest ratings in a national music contest.
III	Arranged a musical composition which was performed in public.
IV	Was a member of the high school choir for one or more years.
V	Was a member of the high school band for one or more years.
VI	Had engaged in some musical activity not school-connected, assumed to require musical training and/or experience; e.g., church organist, member of dance combo.
VII	Was named by one or more teachers as possessing outstanding musical talent.
VIII	Was named by one or more peers as possessing outstanding musical talent.

With the exception of information secured from high school band and choir rosters, assignments of persons to categories of being musical were based upon student self-report forms similar to those used to obtain National Merit Scholarship information, and upon nomination filled out by teachers and students. The student nomination "musical" was one of 46 stimulus items designed to elicit sociometric valuations of boys and girls by their peers. It read, "Name three persons about your own age, whom you may or may not know very well, who have outstanding musical talent. These are people who sing, play an instrument, or dance very well." The teacher nomination instrument was comparable.

Independent Variables

The categories describing the theoretical model in Chapter II were sub-divided, and independent variables to be used as potential predictors were selected, partly on the basis of hypothesized "factors in persons" developed in previous HTRP factor analytic studies. Additional classification was made on the basis of logical analysis. The resulting six classifications within which postulated measures were structured are:

Academic Achievement

Convergent Thinking

Divergent Thinking

Perceptual-Motor Skills

Socially-Oriented Achievement Orientation

Social Adjustment

Employing these six categories as a guide, 41 measures were selected to be used as independent variables. These formed a pool of potential predictors from which subsets of relevant measures were to be obtained by analytical procedures explained later in this chapter. The 41 independent variables are listed below according to the theoretical categories they were hypothesized to represent.

Academic Achievement

1. STEP Listening
2. STEP Science
3. STEP Mathematics
4. CAT Reading Comprehension
5. CAT Reading Vocabulary
6. CAT Mechanics of English
7. CAT Arithmetic Reasoning

Convergent Thinking

8. CTMM Mental Function
9. Gestalt Transformation
10. Rhymes
11. DAT Abstract Reasoning
12. Mutilated Words

Divergent Thinking

13. Consequences
14. Seeing Problems
15. Common Situations

Perceptual-Motor Skills

16. Dotting Test
17. Discrimination Reaction Time
18. Writing X's
19. Copying Test
20. DAT Clerical Speed and Accuracy

Socially-Oriented Achievement Motivation

21. TSAI Scholastic Motivation
22. TSAI Achievement
23. SSHA Achievement Drive
24. SSHA Procrastination Orientation
25. NNAS Need Achievement

Social Adjustment

26. CMAS Anxiety
27. Criticism of Youth
28. CYS Negative Orientation to Society
29. CYS Social Inadequacy
30. JPQ Neurotic Emotionality vs. Stability or Ego-Strength
31. NNAS Need Autonomy
32. NNAS Need Autonomy Anxiety
33. NNAS Need Aggression
34. NNAS Need Aggression Anxiety
35. NNAS Need Isolation Anxiety
36. Dominance vs. Submission
37. Cyclothymia vs. Schizothymia

38. Premsia vs. Harria
39. Index of Social Status
40. Index of Value Orientation
41. Sex-role

Brief descriptions of each of the above variables, including their source and the attributes postulated to be measured, are given in Appendix A.

All of the predictor variables were scores on paper and pencil tests, with the exception of Index of Social Status (ISS), Index of Value Orientation (IVO), sex-role, and community of residence. ISS and IVO were tabulated from family data sheets; information concerning sex-role and community were obtained from school records. The community of residence variable was not included in the procedures for selecting subsets of efficient predictors. The cross validations, which were the final steps in the analyses, were designed to determine whether prediction equations derived in one community could be applied to another.

All predictor scores were transformed to stanine values with a range from "1" to "9" and a mean value of "5" within each community. Data transformed to stanine values were employed for several reasons. This accommodated differences in high and low scoring practices among the four communities, as well as permitting comparisons between tests. Since all data were to be punched on IBM cards for computer processing, the reduction of each set of scores to numbers entered in a single column of an IBM card greatly facilitated the mechanical aspects of data handling, and allowed the inclusion of more scores in certain of the computations. Computer programs were utilized to carry out these transformations as well as the subsequent analyses.

Sample

The sample population for this study was drawn from students in the HTRP population who had just completed 12th grade in 1963, and who had also been enrolled in the same school system in the seventh grade. Out of the total number of students who had been involved in the HTRP at one time or another, only 258 had complete scores on all 41 of the measures selected as independent variables for the present study. In order to obtain a sample of sufficient size to enable meaningful interpretations to be made in the various analyses undertaken, 111 students who had scores missing on three or less of the 41 independent variables were added to those for whom all scores were available. The resulting sample to be analysed consisted of 369 subjects. Means were employed as being the best available estimates of the missing values. Slightly more than one per cent of the total scores used have means substituted for missing information. Table 3.1 shows the distribution of means which were added for missing scores according to community and sex, for the 111 subjects added to those having 41 complete scores. As shown in Table 3.2, the sample population of 369 individuals was made up of a "musical" group of 96 and a "non-musical" group of 273 subjects.

Table 3.1

Distribution of Subjects Having Means Added for Missing Scores on 41 Independent Variables

(N = 111)

Community	Number of Missing Scores	Male	Female	Total Subjects	Total Number of Means Added
A	1	8	4	12	12
	2	3	0	3	6
	3	2	1	3	9
B	1	3	4	7	7
	2	4	0	4	8
	3	2	2	4	12
C	1	9	13	22	22
	2	8	0	8	16
	3	10	1	11	33
D	1	6	10	16	16
	2	8	5	13	26
	3	0	8	8	24
Total		63	48	111	191

Table 3.2

Distribution of 369 Subjects by Community, Sex-role, and Musical *versus* Non-Musical Criterion

Community	Musical		Non-musical		Total
	M	F	M	F	
A	13	29	27	13	82
B	3	5	27	13	48
C	16	14	45	41	116
D	6	10	62	45	123
Total	38	58	161	112	369

Note.-Any student belonging to one or more of eight categories of observed musical behavior was assigned to the "musical" group; any student belonging to none of these categories was assigned to the "non-musical" group.

Analyses

Data were investigated by means of three separate procedures, each involving a different treatment of the criterion. In the first of these a dichotomous "musical vs. non-musical" criterion classification was employed. Any subject belonging to one or more of the eight categories of being musical described earlier in the chapter was assigned a criterion value of "1". Those subjects belonging to none of the musical categories were assigned a value of "0". The second and third analytical procedures involved the use of a scaled "degree of musicality" criterion.

Weighted "Degree of Musicality" Criterion

Weights of "3", "2", or "1" were assigned to each of the eight categories of being musical on the logical basis of the probable talent manifested by an individual belonging to a given category. These category weights are:

Musical Category	Description of Category	Weight (Degree of Musicality)
I	Received 1st place rating in State Music Contest	3
II	Received highest rating in National Music Contest	3
III	Arranged a musical composition for performances	1

Category weights (continued)

Musical Category	Description of Category	Weight (Degree of Musicality)
IV	Was a member of high school choir	2
V	Was a member of high school band	2
VI	Engaged in non-school musical activity	1
VII	Was named by teacher(s) as outstanding musician	1
VIII	Was named by peer(s) as outstanding musician	1

The "degree of musicality" criterion score for each individual was the total of the weights for each of the musical categories of which he was a member. The rationale upon which assignment of weights to categories was made appears in Appendix B. Table 3.3 shows the frequency of designations as musical which were derived from each of the eight categories. Some of the subjects were members of several categorical classifications, which accounts for the total of 179 musical designations for 96 subjects.

The weighted criterion scores which resulted from the procedure just described ranged from "10" to "1" for members of the musical sample. Table 3.4 shows the distribution of these 96 weighted scores according to community and sex.

In employing the criterion just described for the second analysis of the data, the total sample to be investigated was made up of the 96 musical subjects, plus the 273 non-musical subjects. Each of the latter was assigned a criterion score of "0".

The third analysis differed from the second one in that in

Table 3.3

Frequency of Designations for Eight Categories of Musicality Among 96 Subjects Classified as "Musical"

(Categories are not mutually exclusive)

Criterion Categories		Community A		Community B		Community C		Community D		Total Designations in Category
		M	F	M	F	M	F	M	F	
I	First place, State Contest	5	2	1	1	0	0	0	4	13
II	Highest in Nat'l Contest	2	1	0	0	0	0	0	1	4
III	Arranged Music	1	0	0	0	0	1	0	1	3
IV	High School Choir	6	16	0	1	11	6	1	3	44
V	High School Band	5	8	2	4	3	4	2	2	30
VI	Non-School Music	5	15	0	1	3	3	1	5	33
VII	Teacher Nomination	4	6	1	1	1	2	1	1	17
VIII	Peer Nomination	5	5	1	2	8	4	3	7	35
No. Designations		33	53	5	10	26	20	8	24	179
No. "Musical" Subjects		13	29	3	5	16	14	6	10	96

Table 3.4

Distribution of 96 Subjects Among Four Communities

Using a Weighted "Degree of Musicality" Criterion

Weighted Criterion Score	Community A		Community B		Community C		Community D		Sub-Total		Total
	M	F	M	F	M	F	M	F	M	F	
10	1							1	1	1	2
9	1	1							1	1	2
8	1							1	1	1	2
7		1				1		1	1	2	3
6	1		1	1				1	2	2	4
5				1						1	1
4	1	5			3	1	1	2	5	8	13
3	3	7		1	6	2		2	9	12	21
2	3	11	1	1	5	7	3		12	19	31
1	2	4	1	1	2	3	2	2	7	10	17
Totals	13	29	3	5	16	14	6	10	39	57	96

the latter all of the non-musical subjects were omitted from the sample. Table 3.4 shows the distribution of weighted criterion scores for the 96 "musical" subjects according to community and sex categories.

All analyses involved the application of iterative multiple linear regression. The iterative process begins by setting weights of all of the predictor variables at zero. Corrections are then made on one predictor weight at a time until the most suitable combination of weights is obtained for the particular set of variables being used as a model.

Under certain conditions relationships between a criterion and a predictor may be described better by a curvilinear form than by a straight line. Such might be the case, for example, in a comparison between ages of subjects and some measure of physical strength. Both the very young and the very old subjects would tend to have lower physical strength scores than those persons within some middle age range. In the present study a procedure was employed involving the use of second degree polynomial equations, which was designed to indicate significant curvilinear relationships between any of the 41 predictors and the criterion.

In the tests for curvilinearity, as well as in other analyses involving comparison of the effectiveness of prediction of different sets of variables, an F-test was used as the basis for such comparison. The F-test consists of computing a ratio between the squared multiple correlation (RSQ) of the criterion and a given set of predictors (full model), and the RSQ of a set which omits one or more of the predictors (restricted model). The form used in this study is:

$$F = \frac{({R^2}_f - {R^2}_f) \ / \ df_1}{(1 - {R^2}_f) \ / \ df_2}$$

where ${R^2}_f$ = squared multiple correlation (RSQ) for the full model,

${R^2}_r$ = squared multiple correlation (RSQ) for the restricted model,

df_1 = degrees of freedom for the numerator; this is the number of linearly independent variables in the full model minus the number of linearly independent variables in the restricted model,

df_2 = degrees of freedom for the denominator; this is the number of subjects minus the number of linearly independent variables in the full model

(Bottenberg and Ward, 1963, pp. 64-68, 125-126).

Selecting a Subset of Predictors

There are two general approaches to selecting an efficient subset of predictors from a larger number. Theoretically the best method is to drop one variable out of the model at a time successively, measuring the difference in predictive efficiency between the full model (i.e., the equation which includes all of the variables in the set) and the restricted model (i.e., the equation which does not include the particular variable being tested) for each variable in the original set. This process would be continued until every possible combination of variables from one to the complete set had been tested with each variable. Although insuring the absolutely most potent subset of predictors within a given set of data, this method has the disadvantage of being highly impractical, or impossible, when a large number of potential predictors is involved (Bottenberg and Ward, 1963; Schultz and Goggans, 1961).

An alternate procedure is to select the single strongest indicator (this is the independent variable which has the highest correlation with the criterion). The selected variable is then tested in combination with each of the remaining variables to obtain the best two-variable predictive model. This model is subsequently tested with each of the remaining variables in turn, variables being added one at a time in this manner until a suitable ratio of model size to predictive capacity is obtained. Although this method does not insure absolutely the most potent set of predictors, the efficiency lost is said to be statistically insignificant, and of theoretical interest only (Schultz and Goggans, 1961). A virtue of this procedure is its saving in time, compared with the first one described. The latter was used to select models in the present investigation. Decision for inclusion and exclusion of variables was based upon F-tests.

A condition implicit in the use of the regression technique for selection of a set of indicators is that the decision to retain or drop a variable in the completed model be determined by the variable's contribution in the presence of all of the other variables selected. Since the procedure used in this study tests the contribution of a variable only in combination with those which had been selected previously, an additional step was necessary.

The subset selected for the dichotomous criterion, and the ones for the weighted criterion, were each tested as follows: one variable was dropped from the set, and the difference in RSQ's between the two models was tested by the F-ratio. The dropped variable was replaced in the set and another deleted, the F-ratio again furnishing a measure of the independent contribution of the dropped variable; the procedure was continued until all variables had been tested in turn. Only those which contributed significantly in the presence of all of the other variables were retained.

Cross Validation

A set of indicator variables selected according to the above procedure can be used to describe the relationship between these variables and a criterion for a given body of data, within the limits indicated by the RSQ. No safe generalizations can be made concerning the application of such a derived set of weights or measures to another population, or to different bodies of data.

Cross validation has been demonstrated to be a satisfactory procedure for estimating the appropriateness of generalizing information from one group of persons to another (Jennings, 1963; Whiteside, 1964). Briefly, such a procedure consists of applying an obtained predictor model to a given sample of persons, so that the most efficient weight may be assigned to each coefficient on the basis of this sample. The weights derived in this manner are then assigned to the corresponding independent variables in one or more other sample populations. A "predicted" score is computed for each subject, which may then be compared to his actual criterion score. The degree to which the effectiveness of the model is lessened when it is applied to other sample populations indicates its stability. That is, the greater the loss in predictive efficiency, the greater the risk involved in considering the model a valid measure of general behavior. An F-test of obtained RSQ's of various samples is sometimes used as a means for measuring the statistical significance of such differences between samples (Jennings, 1963; Whiteside, 1964).

A modification of the above procedure was suggested by Jennings in personal communication, which appears to be well suited to a situation involving dichotomous criterion classification. This method involves the use of three sample populations for each cross validation. Such a procedure was used in the present study. According to this, the regression information obtained on the first (pre-validation) sample was applied to the second (post-validation) sample in such a way that the predicted score for each individual in the post-validation sample could be compared with his actual score (a "1" for each musical subject, and an "0" for each non-musical subject). Comparison between these predicted scores and the actual scores for each individual in both of the criterion groups furnished a basis for determining an optimum cutting point in the predicted scores of the post-validation sample. Under varying conditions the cutting point may be set at one or another level, in order to improve the number of correct predictions within a particular group, or for some other reason. In the present investigation the cutting point was decided upon which would allow the largest number of correct predictions to be made for both musical and non-musical persons in the post-validation sample. Following this, the obtained regression weights and cutting point were superimposed upon a third (cross-validation) sample. The use of different samples of subjects for each of the procedural steps eliminated possible bias which might have affected selection of the cutting point.

The stability of the predictive model was evaluated by a comparison between the percentage of "hits" (correct predictions within each criterion group resulting from the predetermined cutting point) and the base rate of the cross-validation sample. The base rate is the per cent of correct guesses that would be made simply by knowledge of how many subjects belonged to each of the criterion categories. For example, if a given cross-validation sample was composed of 25 musical and 75 non-musical subjects, the base rate would be 75 per cent. That is, a person would be correct in 75 per cent of the cases just by predicting that every individual was a member of the non-musical category. If the base rate predicted as accurately as the model, then the behavior investigated could not be considered to be generalizable across samples.

Three sets of cross validations were performed, which together involved the use of all four of the community samples. In the first of these Community A was used as the pre-validation sample, Community B as the post-validation sample, and Community C became the cross-validation sample. In the second cross validation, Community A, Community C, and Community D, respectively, were used. In the third application Communities B, C, and A were involved, in that order.

CHAPTER IV

RESULTS AND CONCLUSIONS

The criterion, "musical talent", was defined operationally in Chapter III according to whether or not subjects in the sample qualified in certain musical classifications. Any individual who belonged to one or more of eight categories of observed musical behavior listed in Table 3.3 was designated as "musical". Persons belonging to none of these categories were designated "non-musical".

A number of independent variables were selected because of their possible relevance as indicators of musical talent. These variables appeared to be the best available measures postulated to represent theoretical categories of a contextual model of human behavior; this model considers musical talent to be functionally related to certain intrapersonal and interpersonal characteristics in people, within a socio-cultural context. From this large pool of potential predictors a smaller number was to be obtained which would retain as much as possible of the predictive efficiency of the total number, and at the same time would be of more manageable proportions.

Dichotomous Criterion: Musical _versus_ Non-Musical

In order to gain a clearer understanding of possible predictive usefulness of the selected independent variables in this study, three treatments of the criterion were employed. The first of these combined all subjects belonging to any of the eight categories of being musical into a single group designated as "musical"; each subject in this group was assigned a criterion score of "1". Those subjects belonging to none of the musical categories were designed as "non-musical", and were assigned criterion scores of "0".

To investigate the possibility that the relationship between the criterion and certain of the independent variables might be described better by a curved line than by the straight line form, second degree polynomial equations were applied using each of the predictors in turn.

In the tests using the dichotomous criterion no variable showed curvilinearity at the .01 level of confidence, and only four at the .05 level. Since two would have been expected by chance, the increment of these four to the total effectiveness of the model was considered negligible, and all relationships were regarded as being linear. A table showing results of the tests for curvilinearity appears in Appendix C.

To select an efficient subset of predictors from the larger pool consisting of 41 variables, the procedure of selecting the single most highly correlated indicator first, and then adding successively the one which produced the highest RSQ in combination with this, and then the next, and so forth, was used (Schultz and Goggans, 1961). The single variable of the 41 being tested which had the highest correlation with the dichotomous criterion was Consequences (RSQ = .0511). This therefore became the first indicator in the set. From the remaining variables the one which combined most effectively with this was

Premsia versus Harria (RSQ = .0922). In combination with these two the next variable to be obtained was CYS Social Inadequacy (RSQ = .1186). Successive additions were made to the subset until a total of 10 variables had been selected, with a total obtained RSQ of .1882. Table 4.1 lists each of these 10 potential predictors, indicating the increment in predictive effectiveness which was made to the set obtained previously by each of them, by the RSQ. The F-ratio in the table furnishes an index of the statistical significance of such an increment. Seven variables made statistically significant contributions as they were added successively to the model. These indicator variables were Consequences, Premsia versus Harria, CYS Social Inadequacy, Psychomotor Dotting Test, Mutilated Words, SSHA Procrastination Orientation, and Psychomotor Copying Test. As shown in Table 4.1, all of the theoretical categories set forth in Chapter III were represented by at least one postulated measure, with the exception of Category I, Academic Achievement. The effectiveness of the "full model" consisting of the seven variables listed above was RSQ = .1655, equivalent to a multiple correlation of .4068 between the seven predictors and the criterion.

The next step was to determine whether each of the seven variables made a significant contribution to prediction in the presence of all of the others. Seven "restricted" models, each deleting a different one of the selected predictors, were compared by means of their RSQ's to the full model (RSQ = .1655), using the F-ratio test.

Table 4.1

Cumulative RSQ in Variable Selection Sequence

for "Musical vs. Non-Musical" Criterion

Variable Name	Theoretical Category Represented	Cumulative RSQ	F
Consequences	Divergent Thinking	.0511	
Premsia vs. Harria	Social Adjustment	.0922	16.44 **
CYS Social Inadequacy	Social Adjustment	.1186	11.00 **
Psychomotor Dotting Test	Perceptual-Motor Skills	.1323	5.71 *
Mutilated Words	Convergent Thinking	.1447	5.17 *
SSHA Procrastination Orientation	Socially-Oriented Achievement Orientation	.1556	4.74 *
Psychomotor Copying Test	Perceptual-Motor Skills	.1655	4.30 *
CAT Arithmetic Reasoning	Academic Achievement	.1725	3.04
Rhymes	Convergent Thinking	.1808	3.61
TSAI Achievement	Socially-Oriented Achievement Orientation	.1882	3.21

** Significant at .01 level of confidence.

* Significant at .05 level of confidence.

As can be seen from Table 4.2, which shows the results of these tests, each of the variables made an independent contribution to prediction at the .05 level or greater. The completed model representing this phase of the theory being tested may be described mathematically as follows:

$$Y = a_0U + a_1X_1 + a_2X_2 + \ldots\ldots + a_7X_7$$

where Y = the dichotomous criterion, "musical vs. non-musical",

a_0, a_1, a_2, . . . a_7 = regression weights (coefficients),

U = the unit vector (a "1" for each subject),

X_1 = Consequences,

X_2 = Premsia _versus_ Harria,

X_3 = CYS Social Inadequacy,

X_4 = Dotting Test,

X_5 = Mutilated Words,

X_6 = SSHA Procrastination Orientation,

X_7 = Copying Test.

Table 4.2

F-Tests for Independent Contribution of Variables in a Set Predicting to Dichotomous "Musical vs. Non-Musical" Criterion

(N = 369)

Variable Deleted	Obtained RSQ	F^a
None (Seven-variable "Full" Model)	.1655	
Consequences	.1469	8.08 **
Premsia *versus* Harria	.1266	16.91 **
CYS Social Inadequacy	.1433	9.65 **
Psychomotor Dotting Test	.1559	4.17 *
Mutilated Words	.1473	7.91 **
SSHA Procrastination Orientation	.1555	4.35 *
Psychomotor Copying Test	.1556	4.30 *

** Significant at .01 level of confidence.

* Significant at .05 level of confidence.

a The F-ratio is an index of the independent contribution to prediction of a given variable in a set. It indicates the loss in predictive efficiency of the model from which the variable in question has been deleted, compared with the full model.

The regression weights associated with each of the seven independent variables in the completed model are shown in Table 4.3. These weights, when multiplied by the corresponding measure scores for any individual and then added to the "regression constant", furnish a predicted score on the basis of which the individual would be expected to be a member of a particular criterion group.

A linear model of the type just developed may be put to several kinds of uses. One such use is as a device for describing characteristics of persons included within the sample. A brief explanation of each of the independent variables appears in Appendix A; on the basis of these postulated measures a descriptive analysis may be made. Since only one-sixth of the variance between the musical and non-musical groups is accounted for, such a description is not to be considered highly definitive, but rather a suggested means of interpreting models of this kind.

Consequences was the best single discriminator between "musical" and "non-musical" groups. This is considered by Guilford, McGuire, and others to be an element of originality, or of divergent thinking. It is postulated to measure aspects of conceptual foresight, and the ability to go beyond what is given and extrapolate outcomes. Thus musically inclined persons may be thought of as being better able to look ahead to end results, or to plan their activities to completion, than their non-musical age-mates. This may correspond to what is sometimes referred to musically as a "cadential" feeling.

Table 4.3

Regression Weights Associated with Indicator Variables for Dichotomous "Musical *versus* Non-Musical" Criterion

(N = 369)

Variable Name	Regression Weight	Validities[a]
Consequences	.0488	.23
Premsia vs. Harria	.0854	.21
Social Inadequacy	.0681	.20
Dotting Test	.0347	.18
Mutilated Words	-.0491	.00
Procrastination Orientation	.0311	.16
Copying Test	.0311	.16
Regression Constant	-1.0301	

[a] The validities are the correlations between single variables and the criterion. These are shown in Appendix F.

Premsia versus Harria is postulated to be a measure of emotional sensitivity as opposed to hard realism, or "tough maturity". That this should rank high among discriminators is not surprising, since the musically talented person is frequently regarded as being emotionally sensitive and in some ways not as "practical" as his fellows in other areas of endeavor.

On the basis of CYS Social Inadequacy the musically talented individual may be described as being somewhat withdrawn or unsure in social situations, highly sensitive to ridicule or embarrassment, and as having difficulty in forming close personal relationships with others.

The musical person tends to have somewhat better than average perceptual-motor coordination (Dotting Test, Copying Test), and to possess more skill at interpreting logical symbols than his non-musical peer (Mutilated Words). There is a tendency to "put off" doing things (Procrastination Orientation).

A second use to which a linear model such as the one which has been developed here may be put is as a predictive instrument to be applied to new samples. Some conditions and procedures for this are discussed later in this chapter, in the section dealing with Cross Validation.

Weighted Criterion: Musical and Non-Musical Subjects

In the previous section characteristic differences between musically talented persons and others were evaluated by the most basic dichotomy possible. Scores of "1" and "0" permitted no quantitative or qualitative differentiation among members of the musical group.

In the following procedures one means for accommodating some intragroup differences was employed. Eight categories of being musical are described in Chapter III. Each of these categories represents a somewhat different aspect of observed musical behavior from the others, and may be used as a basis for providing a differentiation scale for persons included in the various categories. Each category was assigned a weight which was calculated to represent the comparative degree of musical talent associated with such a behavior or activity. Some of the factors which were considered in this procedure are described in Appendix B.

Categories I and II were weighted "3"; these included all individuals who had won first place ratings in state musical contests, and those who had won the highest ratings in national music contests. Categories IV and V, which included all students who were members of the respective high school bands and choirs, were assigned a weight of "2". Categories III, VI, VII, and VIII were weighted "1"; these included those persons who had arranged a musical composition which had been performed in public, those who were engaged in some sort of musical activity outside of school, and those who had been named as being musical by either teachers or age-mates.

The "degree of musicality" criterion score of an individual was equal to the total of the weighted scores of all of the categories of which he was a member. Distribution of these scores for the 96 musical subjects, according to community and sex, is shown in Table 3.4.

The possibility that significant curvilinear relationships might exist between this criterion and various of the independent variables was investigated in the same manner as has been described for the dichotomous criterion procedure earlier in this chapter. In tests using the "degree of musicality" criterion only four of the 41 independent variables showed such a relationship at the .05 level of confidence. The possible increment to predictive effectiveness of the model by any of these was considered to be negligible, and all relationships were considered to be linear. A table of the results of the tests for curvilinearity appears in Appendix D.

The procedure employed for reducing the 41-variable pool to a more practical prediction model was identical with the one used for the "musical vs. non-musical" criterion. The single variable which correlated highest with the criterion was Premsia vs. Harria, with an RSQ of .0455. Successive highest contributing variables were added until a set of 10 potential predictors was accumulated. An F-test was applied to measure the contribution of each additional variable. As is shown in Table 4.4, a total of five independentent variables contributed significantly at the .01 or .05 level of confidence. These were Premsia vs. Harria, Psychomotor Copying Test, CYS Social Inadequacy, Consequences, and Common Situations.

To evaluate the independent contribution of each of these indicators in the presence of all of the other four, five restricted models were compared in turn with the full model which included the five indicators just obtained. The restricted models were each made up of four variables, a different one being deleted from each restricted model. Such a procedure is equivalent to assigning a value of zero to the regression weight associated with the deleted variable, in the full model. The independent contribution to prediction of the omitted variable is indicated by an F-ratio; this compares the difference in RSQ between the full equation and the restricted one. Table 4.5 shows the F-ratios resulting from these tests. Each of the five indicator variables contributed significantly to the predictive effectiveness of the obtained model.

These five measures represent three of the six theoretical categories described in Chapter III, namely, Social Adjustment, Perceptual-Motor Skills, and Divergent Thinking. No significant differentiation appears within the categorical areas of Academic Achievement, Convergent Thinking, or Socially-Oriented Achievement Motivation. The RSQ of .1242, or the multiple correlation of .3525, does not

Table 4.4

Cumulative RSQ in Variables Selection Sequence

for "Degree of Musicality" Criterion

(N = 369)

Variable Name	Theoretical Category Represented	Cumulative RSQ	F	
Premsia vs. Harria	Social Adjustment	.0455		
Psychomotor Copying Test	Perceptual-Motor Skills	.0808	14.01	**
CYS Social Inadequacy	Social Adjustment	.1032	8.96	**
Consequences	Divergent Thinking	.1133	4.21	*
Common Situations	Divergent Thinking	.1242	4.54	*
CMAS Ansiety	Social Adjustment	.1315	3.04	
Neurotic Emotionality vs. Stability or Ego Strength	Social Adjustment	.1389	3.08	
Mutilated Words	Convergent Thinking	.1450	2.04	
Seeing Problems	Divergent Thinking	.1521	2.96	
SSHA Procrastination Orientation	Socially-Oriented Achievement Motivation	.1571	2.08	

** Significant at .01 level of confidence.

* Significant at .05 level of confidence.

demonstrate a strong relationship; nevertheless it indicates the likelihood that basic characteristic differences do exist which may be identified and measured.

This completed equation representing the theory being tested may be described mathematically as follows:

$$Y = a_0U + a_1X_1 + a_2X_2 + \; . \; . \; . \; . \; . + a_5X_5$$

where Y = the weighted "degree of musicality" criterion,

$a_0, a_1, \; . \; . \; . \; a_5$ = regression weights (constants),

U = the unit vector (a "1" for each subject),

X_1 = Premsia versus Harria,

X_2 = Copying Test,

X_3 = Social Inadequacy,

X_4 = Consequences,

X_5 = Common Situations.

Table 4.5

F-Tests for Independent Contribution of Variables in a Set Predicting to "Degree of Musicality" Criterion

(N = 369)

Variable Deleted	Obtained RSQ	F
None (Five-variable "Full" Model)	.1242	
Premsia vs. Harria	.0894	14.50 **
Psychomotor Copying Test	.1127	4.79 *
CYS Social Inadequacy	.1039	8.46 **
Consequences	.1112	5.42 *
Common Situations	.1147	3.91 *

** Significant at .01 level of confidence.

* Significant at .05 level of confidence.

The regression weights associated with each of the five independent variables in the model described above are shown in Table 4.6. Predicted scores for subjects are obtained by multiplying each variable score by its assigned weight and adding these to the "regression constant".

A description of differences among persons possessing varying degrees of musicality may be made on the basis of the above model. Although the relationships are not strong, they may serve as indicators of the underlying dimensions postulated. A brief description of this type is furnished in Appendix E.

Weighted Criterion: Only Musical Subjects

A further analysis was made between the 41 independent variables and the "degree of musicality" criterion, this time investigating only the 96 subjects designated as "musical". The purpose of this was to determine whether intragroup differentiation could be made on the basis of these variables.

The procedures involved in obtaining a predictive model were the same as the ones which had been used in the two previous analyses. From the pool of 41 potentially useful variables, the one was selected which correlated most highly with the criterion; additional variables were selected until seven were accumulated successively. As is shown in Table 4.7, three indicators emerged which made statistically

Table 4.6

Regression Weights Associated with Indicator Variables Predicting to "Degree of Musicality" Criterion: "Musical" and "Non-Musical" Subjects

(N = 369)

Variable Name	Regression Weight	Validities[a]
Premsia *versus* Harria	.3685	.21
Copying Test	.1966	.16
Social Inadequacy	.2301	.17
Consequences	.2191	.18
Common Situations	-.1660	.04
Regression Constant	-3.5361	

[a] The validities are the correlations between single variables and the criterion.

significant contribution to the cumulative RSQ of the model. These represented the theoretical categories of Divergent Thinking, Academic Achievement, and Convergent Thinking. The RSQ of the three-variable model was .1297, a slight improvement over the analysis which had included the non-musical group. Table 4.8 shows the results of F-tests to determine whether each of these variables made a significant contribution to prediction in the presence of the remaining ones. As is shown in the table, one variable was significant at the .01 level of confidence, and the other two at the .05 level.

Table 4.7

Cumulative RSQ in Variable Selection Sequence

for "Degree of Musicality" Criterion

Musical Subjects Only

(N = 96)

Variable Name	Theoretical Category Represented	Cumulative RSQ	F
Common Situations	Divergent Thinking	.0359	
CAT Reading Vocabulary	Academic Achievement	.0842	4.93 *
Gestalt Transformation	Convergent Thinking	.1297	4.79 *
Copying Test	Perceptual-Motor Skills	.1520	2.39
CMAS Anxiety	Social Adjustment	.1640	1.29
Criticism of Youth	Social Adjustment	.1837	2.09
Dotting Test	Perceptual-Motor Skills	.1976	1.53

* Significant at .05 level of confidence.

Table 4.8

F-Tests for Independent Contribution of Variables in a Set Predicting to "Degree of Musicality" Criterion: Musical Subjects Only

(N = 96)

Variable Deleted	Obtained RSQ	F
None (Three-variable "Full" Model)	.1297	-
CAT Reading Vocabulary	.0468	8.73 **
Common Situations	.0808	5.15 *
Gestalt Transformation	.0842	4.79 *

** Significant at .01 level of confidence.

* Significant at .05 level of confidence.

The model just completed may be described mathematically as:

$$Y = a_0U + a_1X_1 + a_2X_2 + a_3X_3$$

where Y = the scaled "degree of musicality" criterion,

a_0, a_1, a_2 and a_3 = regression weights (constants),

U = the unit vector (a "1" for each subject),

X_1 = Common Situations,

X_2 = Reading Vocabulary,

X_3 = Gestalt Transformation.

The regression constants associated with each of the three statistically significant variables are shown in Table 4.9. As is indicated by the validities, both Common Situations and Gestalt Transformation demonstrate a negative relationship to the criterion. A description of differences among persons possessing varying degrees of musical talent as represented by the model just developed may be found in Appendix E.

Table 4.9

Regression Weights Associated with Indicator Variables

Predicting to "Degree of Musicality" Criterion:

Musical Subjects Only

(N = 96)

Variable Name	Regression Weight	Validities[a]
Common Situations	-.3864	-.19
CAT Reading Vocabulary	.4980	.17
Gestalt Transformation	-.3254	-.13
Regression Constant	4.3100	

[a] The validities are the correlations between single variables and the criterion.

Cross Validation

A number of studies which have described behaviors of various kinds within selected samples have furnished little or no evidence that such a description would apply to other samples or groups of persons. The present investigation up to this point has been such a descriptive analysis of some characteristics which have some relationship to aspects of musical behavior.

In order to determine whether these kinds of relationships are general ways of behaving, or rather are idiosyncratic to the sample studied, a series of cross validations was performed. The total of 369 subjects was divided into four separate samples according to the community of which each was a member. This distribution is shown in Table 3.2.

As described in Chapter III, the procedure employed for cross validation was one considered to be appropriate to a dichotomous criterion. It involved the use of three samples for each cross validation. The first was used to obtain a set of regression constants for the variables in the model. The second was used as a means of determining an optimum cutting point for the predicted scores. The third sample was the cross validation sample, in which the predetermined weights (regression constants) and cutting point were applied to measure scores to test the validity of the model across samples.

The stability of the predictive model was evaluated by a comparison between the percentage of "hits" resulting from the cross validation, and the base rate of the cross validation sample. The base rate is that per cent of correct predictions which would be made only on the basis of knowledge of number of subjects in each criterion group making up the sample. "Hits" were the number of correct predictions made in either the "musical" or the "non-musical" categories, employing the model.

As described earlier in this chapter (see Table 4.2), seven variables contributed significantly (statistically) to the prediction of musical talent when a dichotomous criterion was employed. Four of these were significant at $p < .01$, and three at $p < .05$. In his studies of cross validation Jennings (1963) found that in general the predictive efficiency of a model is inversely related to the number of predictor variables used in cross validating. That is, other things being equal, a smaller set of variables will retain a greater degree of stability in predicting across separate samples than will a larger set. Consequently, only those four indicator variables were used which had contributed significantly at the .01 level of confidence to the RSQ between the independent variables and the dichotomous criterion. The four were Consequences, Premsia vs. Harria, Social Inadequacy, and Mutilated Words.

Three cross validations were performed, which together involved the use of all four of the community samples. In the first of these Community A was used as the basis for assigning regression weights to the variables (pre-validation sample). These weights were then applied to Community B to determine the optimum cutting point (post-validation sample). The cutting point was set at a score of .830, at which level 85 per cent correct predictions were obtained, a slight improvement over the base rate of 83 per cent for the post-validation sample.

The predetermined regression weights and cutting point were then used as a basis for predicting to the criterion in Community C (cross-validation sample). Table 4.10 shows the results of the cross validation, in which the model operated less effectively (.681) than knowledge of the base rate (.741).

In cross validation II, weights assigned to Community A determined a cutting point of .99 in the Community C sample. Using Community D as the cross-validation sample, the base rate again proved to be as effective as the model, which made no differentiation between musical and non-musical subjects.

Cross validation III involved the use of Community B as the pre-validation sample, Community C as the post-validation sample, and Community A as the cross-validation sample. In this case also, the model proved ineffectual as a differentiator.

Table 4.10

Cross Validation of Prediction Model Among Four Communities

Using Dichotomous "Musical *versus* Non-Musical" Criterion

	Community Samples									
	Pre-Val.	Post-Val.	Cross-Val.	Cutting Point	Hits Mus.	Hits Non-M.	Misses Mus.	Misses Non-M.	% Hits	Base Rate
I.	A	B		.830	1	40	7	0	.854	.833
			C	.830	3	76	27	10	.681	.741
II.	A	C		.990	0	85	30	1	.733	.741
			D	.990	0	107	16	0	.869	.869
III.	B	C		.520	3	84	27	2	.750	.741
			A	.520	2	37	40	3	.476	.512

Conclusions

A number of psychologists and musicians through the years have expressed the belief that musically talented behavior may be a function of, or at least in some way be related to, non-auditory characteristics in persons. The present study provides evidence of a type not previously obtained that such convictions may be testable empirically.

McGuire's context theory of human behavior provides a useful frame of reference within which to organize meaningful sets of cognitive and non-cognitive attributes of the type under consideration. This is especially the case in view of the recent development of multiple linear regression techniques designed specifically to utilize high speed electronic computer analysis. Together, the theoretical framework and the analytical techniques furnish a practical tool for structuring large amounts of data, and extracting from these meaningful descriptive and predictive information.

Statistically the results of the present investigation were modest. In describing differences among persons in a given sample on the basis of observed musical behavior, predictor models accounted for variances ranging from one-sixth (RSQ = .1655) to one-eighth (RSQ = .1242; RSQ = .1297). No results were obtained which supported the hypothesis that such models would retain their predictive efficiency when applied across samples.

Nevertheless, this exploratory study does provide some insight into the understanding of musical talent within its socio-cultural context. In Table 4.11 which consolidates the results of the three separate analyses, can be seen the degree to which each theoretical category contributes to differentiating among persons. Socio-cultural characteristics in general appear to discriminate better than other types of attributes. Cognitive processes give evidence of furnishing additional useful information as these were represented by Divergent Thinking, Perceptual-Motor Skills, and Convergent Thinking.

Table 4.11

Variables Obtained in Models for Three Treatments of Musical Criterion:
Consolidation of Tables 4.2, 4.5, and 4.7

Variable Selected	Treatment of Criterion			Theoretical Category
	Dichotomous (Table 4.2) RSQ = .1655	Weighted (Table 4.5) RSQ = .1242	Weighted (Table 4.7) RSQ = .1297	
Consequences	**	*		Divergent Thinking
Premsia vs. Harria	**	**		Social Adjustment
Social Inadequacy	**	**		Social Adjustment
Copying Test	*	*		Perceptual-Motor Skills
Common Situations		*	**	Divergent Thinking
Mutilated Words	**			Convergent Thinking
Procrastination Orientation	*			Socially-Oriented Achievement Motivation
Dotting Test	*			Perceptual-Motor Skills
Reading Vocabulary			*	Academic Achievement
Gestalt Transformation			*	Convergent Thinking

Note.-Within the particular model designated, each variable made an independent contribution as follows:

** Significant at the .01 level of confidence.
* Significant at the .05 level of confidence.

Of particular interest is the relative importance to prediction of the socially related variables mentioned above, especially in view of the customary neglect of this area in assessing musical talent. Also, a possible answer to some of the questions regarding the relationship between intelligence and musical talent may be indicated by the present investigation. Intelligence as measured by a single instrument (CTMM) made no contribution to any of the models which were developed; however, aspects of cognitive functioning of other kinds were selected in each of the final models. Within the theoretical category of Divergent Thinking, both Consequences and Common Situations demonstrated significant relationships to the criterion, each appearing in two obtained models. Both Mutilated Words and Gestalt Transformation, postulated to measure aspects of Convergent Thinking, made statistically significant independent contributions to prediction in obtained models. This furnishes at least moderate support to the belief that a relationship exists between musical behavior and cognitive or intellectual functioning.

The absence of any significant results in cross validating may be interpreted in several ways. One of these would be that perhaps no common set of psychological attributes exists among different groups of persons which would be useful in identifying musically talented persons. There is evidence to support this view, at least insofar as assessments based on superficial characteristics and stereotypes are concerned (Farnsworth, 1961a, 1961b). An alternate interpretation is that for one reason or another the present investigation failed to touch underlying dimensions in persons to a degree that would uncover general measurable ways of behaving. In view of the restrictions imposed by using already collected data, the latter explanation appears to be a reasonable one for the present time.

The advisability of basing an investigation of the highly specialized area of musical talent upon such diversified information as was incorporated in the Human Talent Research Project deserves some comment. Inherent limitations were apparent from the outset. Of greater importance, however, was the wealth of data resources which was available, and which lent itself to such a study for which no antecedent research furnished a clue as to direction or content.

In brief, this study appears to have made two significant contributions to the understanding of musical behavior. First, some significant, albeit modest, relationships have been demonstrated empirically which can serve as focal points for more intensive investigation in the future. Second, a highly efficient means for organizing a large body of diversified data into a meaningful dimension has been shown to be well suited to the study of aspects of a complex behavior such as musical talent.

CHAPTER V

SUMMARY AND IMPLICATIONS

The purpose of this study was to investigate some possible significant relationships between musical performance and variables representing aspects of non-auditory characteristics in persons, in terms of a transactional or context theory of human behavior. A research model expressed a particular behavior or potential such as musical talent as a function of personality and cognitive variables assumed to operate within the individual, his attitudes and expectancies which may be considered to be motivational or inhibiting, as well as the manner in which other persons act toward or regard him, all interacting within a socio-cultural context. Subjects were students in the 1963 graduating class of four Texas high schools who were divided into two operationally defined criterion categories, "musical" and "non-musical". The "musical" subjects included those students belonging to one or more of eight classifications of observed musical behavior. The "non-musical" group was composed of students belonging to none of these eight classifications.

The independent variables were 41 measure scores postulated to represent pertinent aspects of the various theoretical categories of the research model. Multiple linear regression analyses were used to select the most efficient linear combination of indicator variables representing the theoretical categories, by two methods. The first of these predicted to a dichotomous "musical vs. non-musical" criterion in which all musical subjects were assigned a score of "1", and all non-musical subjects were assigned a "0"; the second employed a weighted "degree of musicality" criterion in which each subject was assigned a score based upon the various classifications of observed musical behavior of which he was a member. F-tests of squared multiple correlations (RSQ) were applied to compare the predictive efficiency of various obtained models or sets of variables. The models (linear combinations) derived in the above reductions were tested for validity by cross validation; that is, by applying regression weights obtained from one high school sample to the other high school samples.

Seven variables made significant independent contributions within a model predicting to the dichotomous "musical vs. non-musical" criterion. The variance accounted for by this set of variables (squared multiple correlation) was .1655. These measures represented the theoretical categories of Social Adjustment, Divergent Thinking, Perceptual-Motor Skills, Convergent Thinking, and Socially-Oriented Achievement Motivation. Two models were derived which predicted to the "degree of musicality" criterion. One of these involved the total sample including musical and non-musical subjects, resulting in an RSQ of .1242; the second included only the musical group, and obtained an RSQ of .1297.

In order to test the stability of measures of this kind using separate samples, a series of three cross validations was performed. Each of the four communities was treated as a separate sample, and each cross validation involved three samples. Since this resulted in a reduced number of subjects for each sample, only the dichotomous criterion was used. The four independent variables which predicted to this criterion at p .01 were used as a model. For each cross validation, regression weights were obtained from one sample. These were imposed upon a second sample to determine an optimum cutting point for correct predictions in this second sample. Following this the obtained weights and the cutting point were applied to the third sample in order to get an unbiased assessment of the stability of the predictive model. Each of the three cross validation procedures failed to improve prediction over the base rate of the third sample.

The moderate statistical support forthcoming in the initial analyses was interpreted as an encouraging sign that this type of investigation warrants further consideration. This optimistic view was based partly upon the fact that with little or no previous empirical evidence to furnish guide lines for this particular type of exploration, the study nevertheless produced some significant and useful information regarding musical behavior. Also, this statistical contribution was obtained in spite of certain limitations imposed by the nature of the data used.

Implications

(1) The complexity of relationships among variables which may enter into the assessment of musical talent is apparent from results of this study. Thus one might hazard the suggestion that bivariate investigations of such a behavior are of only limited value in terms

of understanding, except within some sort of larger theoretical framework.

(2) Extension of the present type of research may give rise to some exciting possibilities in the field of music education. If further investigations reveal additional psychological concomitants of musical talent, then use of suitable measures early in a child's school career might open the field of musical training to some children to whom it is not now available, because of their experiential deprivation. That is, if attributes such as those discussed here are shown to play a vital role in successful musical activity, then perhaps such factors as deficient pitch discrimination may be overcome by intensive programs such as those which have already been demonstrated successfully on a limited scale.

(3) At a different level of education, the "closing college door" has emphasized the likelihood that to an increasing degree college entrance will be limited to those manifesting the greatest probability for successful completion of the course of study. At present it is not unusual to find music schools who have a rate of attrition as high as 50 per cent between admission and graduation. Most students admitted have demonstrated musical proficiency in one or another area as a basis for acceptance. Further research along the general line of the present study might show some promise of developing a practical instrument for evaluating relevant cognitive and non-cognitive attributes of persons who are equally proficient performers, so that college entrance decisions could be assisted by some organized means for predicting those who are "temperamentally" suited to pursue intensive study

of music.

(4) Certain limitations of this study have been mentioned earlier. One question which could not be answered by the available information warrants serious consideration: namely, would those variables which contribute to identifying musical talent in the present study retain their significant independent contribution in the presence of conventional measures of musical talent? If so, then these two types of instruments used in combination would make a substantial addition to the understanding and prediction of this behavior.

(5) Future investigations undoubtedly could profit by the inclusion of some variables more closely tied to music itself, as well as those non-auditory aspects investigated in this study.

APPENDIX A

DESCRIPTION OF INDEPENDENT VARIABLES

Below is a brief description of each of the variables selected as possible predictors in the present study. This includes the characteristic postulated to be measured, the source of the test, and the grade in school during which the present scores were obtained (in parenthesis, following test name).

STEP Listening (12) One of the Sequential Tests of Educational Progress. Scores based upon responses indicating comprehension of passages and questions read aloud. Postulated to measure cognitive apprehension, efficiency in attending to and concentrating upon verbal stimuli during learning process (Cooperative Testing Division, 1958).

STEP Science (12) One of Sequential Tests of Educational Progress. Scores based upon responses designed to measure knowledge of basic concepts in each major area of science, and problem solving skills needed to apply scientific knowledge to familiar and unfamiliar situations. (Cooperative Testing Division, 1958).

STEP Mathematics (12) One of Sequential Tests of Educational Progress. Scores designed to be a measure of overall achievement in broad mathematical objectives in education. The concepts tested are number and operation, symbolism, measurement and geometry, function and relation, proof: deductive and inferential reasoning, probability and statistics

(Cooperative Testing Division, 1958).

CAT Reading Comprehension (9) California Achievement Tests; subtest of CAT Reading. Postulated to measure ability to follow directions, reference skills, and interpretations.

CAT Reading Vocabulary (9) California Achievement Tests; subtest of CAT Reading. Postulated to measure vocabulary in mathematics, science, social studies, and general.

CAT Arithmetic Reasoning (9) California Achievement Tests; subtest of CAT Arithmetic. Postulated to measure meanings, symbols, rules, equations, and problems.

CAT Mechanics of English (9) California Achievement Tests; subtest of CAT Language. Postulated to measure capitalization, punctuation, word usage.

CTMM Mental Function (9) California Test of Mental Maturity: short form for junior high school. Intelligence (IQ) postulated to be measured by ability to respond appropriately to language and non-language stimuli having to do with spatial relationships, logical reasoning, numerical reasoning, and verbal concepts (California Test Bureau, 1957).

Gestalt Transformation (9) One of Guilford Factor Tests (GFT). Postulated to measure an aspect of conceptual redefinition, ability to shift the function of a part of an object and use it in a new way, by responses to items such as "indicate which of five objects has a part which could be used in carrying out a stated operation" (Guilford, 1959; Guilford and associates, 1951).

Rhymes (10) One of Guilford Factor Tests (GFT). Postulated to measure an aspect of word fluency or verbal facility by listing words satisfying a specified requirement, such as "write words that rhyme with given words". (Guilford, 1959; Guilford and associates, 1951).

DAT Abstract Reasoning (10) Differential Aptitude Test, Form A. Postulated to measure ability to infer and demonstrate deductions from a series of problem figures (The Psychological Corporation, 1947).

Mutilated Words (9) Kit of Reference Tests (KRT). Postulated to measure an aspect of symbolic closure or recognition of symbols, by identifying words composed of partial letters (Guilford, 1957; Wilson and associates, 1954).

Consequences (9) One of Guilford Factor Tests (GFT). Postulated to measure an aspect of conceptual foresight, ability to go beyond what is given and extrapolate outcomes, and to be an element of originality, by responses to items such as "list different consequences or possible results of changes in human or natural situations" (Guilford, 1959; Wilson and associates, 1953).

Seeing Problems (9) One of Guilford Factor Tests (GFT). Postulated to measure an aspect of sensitivity to problems, awareness that problems exist, by responses to items such as "list problems that might arise in connection with the structure, use, or operation of common objects" (Guilford, 1957; Wilson and associates, 1954).

Common Situations (9) One of Guilford Factor Tests (GFT). Postulated to measure an aspect of ideational fluency, ability to call up as many ideas or responses as possible in a given time, by responses to items such as "list problems suggested by everyday situations" (Guilford, 1959; Wilson and associates, 1954).

Dotting Test (7) Psychomotor Test II (PMT). Postulated to measure psychomotor speed and precision, by responses to "place three pencil dots in each of a series of small circles". One of a series of psychomotor tests used by special permission of the Air Research Development Command, U. S. A. F., Lackland Air Force Base, Texas (Air Training Command Publication Bml 22).

Discrimination Reaction Time (DRT) (7) Psychomotor Test II (PMT). Postulated to measure discrimination reaction time, by responses to "place a check mark in an appropriate space according to the position of a white circle in relation to a black circle in a preceding square" (see reference for Dotting Test).

Writing X's (7) Psychomotor Test II (PMT). Postulated to measure psychomotor precision and speed by response to item such as "place an X in each square so that lines touch but do not go outside of corners" (see reference for Dotting Test).

Copying Test (7) One of a kit of selected Tests for Reference Aptitude and Achievement Factors. Postulated to measure speed, accuracy, and flexibility of closure (Educational Testing Service).

DAT Clerical Speed and Accuracy (7) Differential Aptitude Test, Form A. Postulated to measure quickness and accuracy of making comparisons between two lists of letter and number combinations.

TSAI Scholastic Motivation (9) Subscale of Talent Study Attitude Inventory. Postulated to measure scholastic motivation by responses to items such as "I believe that teachers go into teaching mainly because they enjoy it", and "I waste too much time talking, watching T.V., listening to the radio, going to movies, etc., for the good of my studies".

TSAI Achievement (9) Subscale of Talent Study Attitude Inventory. Postulated to measure attitudes relating to academic achievement by responses to items such as "At the beginning of a study period I set up a goal as to how much material I will cover".

SSHA Achievement Drive (7) Subscale of Survey of Study Habits and Attitudes. Postulated to measure an aspect of motivational orientation toward scholastic achievement, by responses to items such as "Whether I like a subject or not, I still work hard to make a good grade" (Brown, McGuire, and Holtzman, 1955).

SSHA Procrastination Orientation (7) Subscale of Survey of Study Habits and Attitudes. Postulated to measure an aspect of academic attitude toward scholastic achievement, by responses to items such as "unless I really like a subject, I believe in only doing enough to get a passing grade" (Brown, McGuire, and Holtzman, 1955).

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NNAS Achievement (8) One of Need-Need Anxiety Scales. Postulated to measure the tendency to seek out situations in which evaluations of standards of excellence are easily made and in which one has a good chance of rating high, by responses to items such as "I set very high goals for myself which I try to reach" (Child, Frank, and Storm, 1956).

CMAS Anxiety (12) Children's Manifest Anxiety Scale. Postulated to measure underlying anxiety or the motive to avoid failure, especially in ego-involving, threatening, or stressful situations, by responses to items such as "I have trouble making up my mind", "My hands feel sweaty", "I worry about what other people think of me" (Phillips, King, and McGuire, 1959).

CYS Criticism of Youth (12) Scale from Texas Cooperative Youth Studies. Postulated to measure a set to find fault with one's age-mates and criticize their behavior, reflecting pressures toward social conformity manifested by a concern for good appearances, by means of responses to items such as "Silliness is one of the worst faults of most teen-agers", and "Teen-agers gossip too much about each other" (Phelps and Horrocks, 1958).

CYS Negative Orientation to Society (12) Scale from Texas Cooperative Youth Studies. Postulated to measure an aspect of the alienation syndrome which is marked by distrust, egocentrism, pessimism, resentment, and anxiety, by responses to items such as "When you get right down to it no one cares much what is going to happen to you", and "A person should insist on his own rights no matter what the cost" (Phelps and Horrocks, 1958).

CYS Social Inadequacy (12) Scale from Texas Cooperative Youth Studies. Postulated to measure an aspect of interpersonal competence in terms of a lack of ability to interpret the intentions of others and inability to form person-to-person relationships, by responses to items such as "I have trouble making friends easily", and "I'm afraid people will laugh at me because I'm not sure how to act" (Phelps and Horrocks, 1958).

Neurotic, Fearful Emotionality versus Stability or Ego-Strength (12) Scale from Junior Personality Quiz. Postulated to measure aspects of neuroticism compared with self-confidence and ego-strength, by responses to items such as "When people play a joke on you, do you usually enjoy it too, without feeling at all upset?" (Cattell and Beloff, 1953).

NNAS Autonomy (8) One of Need-Need Anxiety Scales. Postulated to measure the need for autonomy in such terms as independent decisions and action (Child, Frank, and Storm, 1956).

NNAS Autonomy Anxiety (8) One of Need-Need Anxiety Scales. Postulated to measure self-perceptions of uneasiness and anxiety arising from expression of the autonomy needs (Child, Frank, and Storm, 1956).

NNAS Aggression (8) One of Need-Need Anxiety Scales. Postulated to measure such aspects as willingness to coerce or injure another person when threatened or frustrated, by responses to items such as "I get into a fighting mood when the situation demands it" (Child, Frank, and Storm, 1956).

NNAS Aggression Anxiety (8) One of Need-Need Anxiety Scales. Postulated to measure anxiety about one's own aggressive behavior or tendencies, and about the discomfort which may result in other people, by responses to items such as "I hate any form of argument and I will go out of my way to avoid it" (Child, Frank, and Storm, 1956).

NNAS Isolation Anxiety (8) One of Need-Need Anxiety Scales. Postulated to measure anxieties or fears related to being isolated, by responses to such items as "Being alone gets on my nerves" (Child, Frank, and Storm, 1956).

Dominance versus Submission (12) Factor E of Sixteen Personality Factor Questionnaire. Postulated to measure aspects of assertiveness and self-assurance, by responses to items such as "I make smart, sarcastic remarks to people if I think they deserve it" (Cattell, Saunders, and Stice, 1957).

Cyclothymia versus Schizothymia (12) Factor A of Sixteen Personality Factor Questionnaire. Postulated to measure the degree to which a person prefers occupations dealing with people and socially impressive situations instead of working alone and avoiding clashes of viewpoints ("participating vs. standoff"), by responses to items such as "I would prefer to work in a business 1) keeping accounts and records 2) in between 3) talking to customers" (Cattell, Saunders, and Stice, 1957).

Premsia versus Harria (12) Factor I of Sixteen Personality Factor Questionnaire. Postulated to measure emotional sensitivity as opposed to "tough maturity", being excitable vs. being phlegmatic, with imaginative, aesthetic mind and impracticality in general affairs, by responses to items such as "I would rather be 1) a construction engineer 2) uncertain 3) a teacher of social studies" (Cattell, Saunders, and Stice, 1957).

Index of Social Status (ISS) (9) Postulated to indicate variations in learning experiences resulting from pressures and reinforcement from members of the family, and in expectations held for the boy or girl by school people, derived from weighted values for occupation, income source, and education of the status parent. Low score indicates high status (McGuire, 1953; McGuire and White, 1955).

Index of Value Orientation (IVO) (7) Postulated to indicate variations in life style of family, derived from weighted values for status parent's educational attainment, religious affiliation, occupation, and source of income. Low score indicates high value orientation (McGuire, 1952; McGuire and White, 1955).

APPENDIX B

Explanation of Weighted "Degree of Musicality" Scores

Each of the eight categories of observed musical behavior described in Chapter III was assigned a weight on the basis of the postulated "musical importance" of that category. Decisions for assigning these weights were made in answer to the question, "What relative degree of musical talent would probably have to be demonstrated in order for an individual to belong to a particular criterion category?" Or, conversely, "What is the likelihood that an individual could have become a member of a particular category solely by chance, or on the basis of "visibility", or other characteristics which were not music-connected?"

Texas high school band, choral, and orchestral programs are conducted under the auspices of the University Interscholastic League (UIL). All schools are classified for competition according to size into five categories which range from Class AAAA (over 1000 students) through AAA, AA, A, and B (smallest high schools).

UIL contest performance ratings range from I (superior), through II (excellent), through V (very poor). Both bands and choirs are judged in competition on two types of performance: concert, and sight-reading. The concert performance consists of musical selections which the organization has chosen and rehearsed at length for the best possible rendition. The sight-reading performance consists of playing selections which are unfamiliar to both the director and the students, after only a few minutes of perusal. The purpose of these two types of competition is to tap different aspects of the musical ability of high school musical groups.

In order to get as complete a picture as possible of the level of musical talent represented by each of the four high schools included in the present study, specific information was requested and received from each school with respect to the years 1959-60 through 1962-63. A summary of these data follows:

1. During this four-year period three of the high schools were Class AAAA, and the fourth was AAA. Since 1963 the fourth school has moved into Class AAAA, so that all of these represent a rather large operation.

2. A total of 64 band and choir ratings was given the four schools in UIL competition during the four years being described. 36 ratings of I (superior) and 28 ratings of II (excellent) were awarded the eight organizations during this time. No rating of less than "excellent" was received. This information is tabulated on a following page in Appendix B. Since each performing group was in large school competition, one may conclude that membership in any of these organizations constituted a professional judgment of the individual as being musically talented, rather than selection on some other basis. As a result of this judgment, membership in any of the high school bands or choirs was assigned a criterion weight of "2".

3. Any student who is a member of a band or choir entered in UIL competition is eligible to enter solo contests under the same auspices, with the approval of his director. Solo competition in both instrumental

and vocal fields is judged according to the same five-point rating scale ranging from I (superior) to V (very poor). On the basis of the individual assessments which are made under solo competition conditions, any student receiving highest ratings in either state or national music contests was assigned a weight of "3", in the scaled "degree of musicality" criterion.

4. No means was available for making more definitive assessments of the musical categories which included activities outside of school, arranging musical selections which were given public performances, or peer and teacher nominations as "musical". Therefore each of these classifications was weighted "1", except that if an individual received more than 10 nominations as "musical" he was assigned an additional score of "1" for each additional 10 nominations.

B-4

Performance Ratings of Bands and Choirs of Four Texas High Schools for the Period 1959-60 through 1962-63

Year	Type Performance	School A B.	School A Ch.	School B B.	School B Ch.	School C B.	School C Ch.	School D B.	School D Ch.
1959-60	Concert	I	I	II	II	II	I	I	I
	Sight-Read.	I	II	II	I	II	I	I	I
1960-61	Concert	II	II	I	I	II	II	I	II
	Sight-Read.	II	II	I	I	II	I	I	II
1961-62	Concert	I	II	II	I	II	II	I	II
	Sight-Read.	I	II	II	I	II	II	I	II
1962-63	Concert	I	I	I	I	II	I	I	I
	Sight-Read.	I	II	I	I	II	I	I	I

Note:--Ratings are based on a five-point scale: I (superior), II (excellent), III (average), IV (poor), V (very poor).

APPENDIX C

F-Tests for Curvilinearity

Criterion: Musical *versus* Non-Musical

Test	RSQ-Full	RSQ-Rest.	F-Ratio
STEP Listening	.0021	.0014	.269
STEP Science	.0015	.0000	.577
STEP Mathematics	.0048	.0021	1.038
CAT Reading Comprehension	.0032	.0031	.038
CAT Reading Vocabulary	.0001	.0001	.000
CAT Mechanics of English	.0051	.0051	.000
CAT Arithmetic Reasoning	.0013	.0013	.000
CTMM Mental Function	.0068	.0055	.500
Gestalt Transformation	.0052	.0048	.154
Rhymes	.0209	.0177	1.280
DAT Abstract Reasoning	.0021	.0017	.154
Mutilated Words	.0152	.0004	5.920*
Consequences	.0466	.0464	.080
Seeing Problems	.0271	.0243	1.120
Common Situations	.0082	.0076	.231
Dotting Test	.0315	.0285	1.200

(Table continued on next page)

C-2

Test	RSQ-Full	RSQ-Rest.	F-Ratio
Discrimination Reaction Time	.0047	.0047	.000
Writing X's	.0006	.0005	.040
Copying Test	.0238	.0233	.200
DAT Clerical Speed and Accuracy	.0064	.0028	1.440
TSAI Scholastic Motivation	.0120	.0008	4.480*
TSAI Achievement	.0125	.0100	1.000
SSHA Achievement Drive	.0071	.0053	.720
SSHA Procrastination Orientation	.0174	.0168	.240
Need Achievement	.0145	.0001	5.760*
CMAS Anxiety	.0030	.0030	.000
CYS Criticism of Youth	.0025	.0020	.200
CYS Negative Orientation to Society	.0058	.0008	2.000
CYS Social Inadequacy	.0321	.0298	.958
JPQ Neurotic Emotionality vs. Stability or Ego-Strength	.0076	.0076	.000
Need Autonomy	.0017	.0003	.560
Need Autonomy Anxiety	.0037	.0029	.320
Need Aggression	.0058	.0055	.120
Need Aggression Anxiety	.0134	.0133	.040
Need Isolation Anxiety	.0073	.0071	.080
Dominance vs. Submission	.0109	.0000	4.360*

(Table continued on next page)

C-3

Test	RSQ-Full	RSQ-Rest.	F-Ratio
Cyclothymia vs. Schizothymia	.0028	.0026	.080
Premsia vs. Harria	.0403	.0402	.042
Index of Social Status	.0064	.0025	1.560
Index of Value Orientation	.0105	.0048	2.280

* Variables significantly curved @ .05 level of confidence

Brief descriptions of each of the above variables are given in Appendix A.

Note.- In the above tests for curvilinearity second degree polynomial equations were applied using each independent variable in turn.

The first column (RSQ Full) shows the squared multiple correlation of the simple variable score plus its squared score to the criterion. The second column, (RSQ Rest.), shows the squared correlation of the simple variable with the criterion. The difference in predictive efficiency (explanation of variance between criterion and predictors) is indicated by the F-ratio shown in column three.

APPENDIX D

F-Tests for Curvilinearity

Criterion: Degree of Musicality

Test	RSQ-Full	RSQ-Rest.	F-Ratio
STEP Listening	.0068	.0068	.000
STEP Science	.0044	.0031	.520
STEP Mathematics	.0173	.0000	6.920**
CAT Reading Comprehension	.0078	.0077	.040
CAT Reading Vocabulary	.0078	.0073	.200
CAT Mechanics of English	.0171	.0159	.480
CAT Arithmetic Reasoning	.0023	.0010	.520
CTMM Mental Function	.0182	.0158	.960
Gestalt Transformation	.0135	.0012	4.920*
Rhymes	.0296	.0251	1.800
DAT Abstract Reasoning	.0032	.0032	.000
Mutilated Words	.0108	.0001	4.280*
Consequences	.0356	.0356	.000
Seeing Problems	.0326	.0281	1.875
Common Situations	.0017	.0017	.000
Dotting Test	.0324	.0277	1.958

(Table continued on next page)

D-2

Test	RSQ-Full	RSQ-Rest.	F-Ratio
Discrimination Reaction Time	.0050	.0050	.000
Writing X's	.0013	.0013	.000
Copying Test	.0325	.0325	.000
DAT Clerical Speed and Accuracy	.0069	.0052	.680
TSAI Scholastic Motivation	.0077	.0010	2.577
TSAI Achievement	.0061	.0038	.920
SSHA Achievement Drive	.0053	.0038	.600
SSHA Procrastination Orientation	.0228	.0181	1.880
NNAS Achievement	.0116	.0000	4.640*
CMAS Anxiety	.0046	.0009	1.480
CYS Criticism of Youth	.0102	.0094	.320
CYS Negative Orientation to Society	.0070	.0007	2.520
CYS Social Inadequacy	.0367	.0367	.000
JPQ Neurotic Emotionality vs. Stability or Ego-Strength	.0108	.0098	.400
NNAS Autonomy	.0008	.0008	.000
NNAS Autonomy Anxiety	.0021	.0020	.040
NNAS Aggression	.0040	.0039	.040
NNAS Aggression Anxiety	.0154	.0154	.000
NNAS Isolation Anxiety	.0076	.0057	.760

(Table continued on next page)

D-3

Test	RSQ-Full	RSQ-Rest.	F-Ratio
Dominance vs. Submission	.0033	.0006	1.080
Cyclothymia vs. Schizothymia	.0049	.0040	.360
Premsia vs. Harria	.0433	.0431	.083
Index of Social Status	.0093	.0046	1.880
Index of Value Orientation	.0125	.0076	1.960

** Significantly curved @ .01 level of confidence.

* Significantly curved @ .05 level of confidence.

Brief descriptions of the above variables are given in Appendix A.

Note.- In the above tests for curvilinearity second degree polynomial equations were applied using each independent variable in turn.

The first column (RSQ Full) shows the squared multiple correlation of the simple variable score plus its squared score to the criterion. The second column (RSQ Rest.) shows the squared correlation of the simple variable to the criterion. The difference in predictive efficiency (explanation of variance between criterion and predictors) is indicated by the F-ratio shown in column three.

APPENDIX E

Description of Characteristic Differences Among Persons on the Basis of a Weighted Criterion Representing "Degree of Musicality"

In Chapter IV differences between operationally defined "musical" and "non-musical" groups were described in terms of seven measures which were postulated to represent underlying dimensions in persons. The degree of relationship as shown by the amount of variance accounted for by these measures was not a strong one; however, it was such that the descriptions may be considered to be more than mere conjecture. The criterion was a "musical vs. non-musical" dichotomy.

Two additional analyses were made, each using a slightly different treatment of the criterion. Both of these used a weighted criterion in which categorical definitions of certain musical activities were used as the basis for assigning scores to subjects. The weighting procedures are explained in Chapter III, with some additional information supplied in Appendix B. The first of these analyses employed all of the 369 subjects of the study; those designated as "musical" (N = 96) were assigned criterion scores ranging from "10" (most musical) to "1", while the "non-musical" subjects (N = 273) had "0" scores, as in the previous tests. The second weighted criterion analysis used only the 96 subjects who were designated as "musical", the evaluation being made on the basis of the characteristic differences evidenced in relation to the criterion scores which ranged from "10" to "1".

The strength of the relationships was such that results cannot be interpreted as being highly definitive, and yet they appear to be more than happenstance. Below are characteristic descriptions of the persons involved, based upon theoretical underlying dimensions which these measures are postulated to be tapping. A summary of each of the measures appears in Appendix A.

Weighted Criterion: Musical and Non-Musical Subjects

Five independent variables combined to differentiate among persons who were classified weighted criterion scores of being more or less musical which ranged from "10" (most musical) to "0" (non-musical). These variables suggest that the following characteristic differences may be ascribed.

Musically talented persons may be characterized as being somewhat more excitable as opposed to phlegmatic, to be imaginative and aesthetic, and to be less practical in general affairs than their non-musical agemates. Musicality appears to include an emotional sensitivity, while non-musical persons possess more of a hard realism, or "tough maturity". (Premsia *versus* Harria).

Some aspects of perception and motor coordination are evidenced to a higher degree among musical persons than others (Copying Test). Within the domain of interpersonal relationships the more musical person tends to lack ease and assurance, and to be susceptible to embarrassment, which might result in his having some difficulty in establishing close relationships with other persons (Social Inadequacy).

The last two indicators which made a statistically significant contribution to the predictive model were both within the theoretical category of Divergent Thinking. This aspect of one's intellectual processes is not considered to be antagonistic to conventional ways of doing things, but rather is postulated to be a different type of functioning characterized by conceptual foresight and the ability to anticipate outcomes and end results (Consequences), as well as the ability to supply a number of alternatives within a given frame of reference (Common Situations).

Although stereotyped notions of persons are sometimes unwarranted and do injustice to the individual concerned (Farnsworth, 1961a, 1961b), nevertheless common sense and logical evaluations sometimes prove to be compatible with empirical investigations. Such appears to be the case in the present situation. Thus, partly in the realm of conjecture, one might interpret the differentiation indicated by the last two indicator variables in the following fashion: In planning a program, rehearsing a piece of music, or in composing or arranging a musical number, the musician profits from being able to conceptualize the task in its entirety; this includes the overall structure or formal design, as well as the operation, or the act of performing itself. The same musical selection can be presented in a variety of different ways, and the successful performer has the knack of anticipating which of these ways is the most likely to have the desired effect upon the listener. The composer or arranger must stay within certain bounds of musical convention in order to communicate with an audience, but he has the apparent ability to draw upon resources which will inject freshness or variety within these conventional limitations.

Weighted Criterion: Only Musical Subjects

Three variables made independent contributions to a predictive model which indicated measurable differences among persons defined as musical. On the basis of these indicators, persons possessing musical talent may be described as follows:

Significant differentiation among musically talented persons lies within the area of various intellectual functions. A person's reading vocabulary has some positive relationship to the degree of musical talent which he manifests, while both Common Situations and Gestalt Transformation are negatively related to the criterion, as indicated by the validities shown in Table 4.9. These latter would suggest that among talented individuals the higher the degree of this talent the less ideational fluency and ability to redefine conventional things exists. This may indicate a particular kind of cognitive "set" involved mainly with ideas within the musical domain, which could be tapped more effectively by specially designed measures.

APPENDIX F Intercorrelation of Criterion and Indicator Variables

(Decimals omitted)

NAME OF VARIABLE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
1 Degree of Musicality	100	79	08	04	00	13	09	09	11	04	03	16	04	18	15	00	00	14	00	16	03	06	00	-10	00	03	04	06	12	00	13	05	00	-07	04	07	21	10	-04	17	-09	-12	-14
2 Musical vs. Nonmusical		100	07	02	04	11	07	04	10	00	03	15	12	23	17	04	00	18	-05	16	06	06	02	-07	00	04	08	10	16	-07	13	04	03	-09	04	06	21	37	00	20	-07	-09	-17
3 STEP Listening			100	58	49	50	60	62	54	50	62	40	30	28	31	40	28	20	00	27	24	20	00	00	11	21	01	23	25	-09	12	16	00	03	-07	00	14	00	-25	00	-29	-30	-11
4 STEP Science				100	59	46	48	59	60	55	62	30	24	20	19	47	16	08	00	29	22	05	-16	15	11	11	-08	13	20	-15	-12	13	-04	06	-21	-19	-18	-10	-15	00	-24	-28	27
5 STEP Mathematics					100	55	53	58	45	63	66	33	23	18	20	48	24	11	03	40	27	10	-13	17	20	08	-08	13	18	-10	-08	12	00	12	-09	-12	-21	-08	-08	-08	-27	-28	24
6 CTMM Mental Function						100	57	61	54	58	53	43	25	26	17	34	21	16	00	40	23	24	-09	12	13	17	-03	30	27	-06	04	13	-07	00	-08	04	08	00	-23	-05	-26	-29	-06
7 CAT Reading Comprehension							100	72	67	62	47	50	40	33	38	36	24	00	39	39	31	24	-01	03	21	27	00	31	32	-12	04	05	-05	03	-04	-04	10	-05	-23	-14	-30	-33	-07
8 CAT Reading Vocabulary								100	68	67	52	47	34	30	30	41	33	26	00	38	28	26	-04	05	16	20	-06	32	31	-10	10	09	00	00	04	-06	06	00	-22	-04	-26	-29	-11
9 CAT Mechanics of English									100	64	51	53	37	38	37	34	44	37	06	40	26	35	30	02	11	32	04	41	38	-08	19	00	00	-06	02	07	14	00	-22	-18	-33	-34	-20
10 CAT Arithmetic Reasoning										100	59	47	34	30	29	40	31	21	07	43	27	22	-05	14	19	23	-07	32	28	-10	09	09	05	00	-08	00	-05	-06	-19	-08	-33	-28	-02
11 Abstract Reasoning											100	41	24	24	27	41	29	33	00	44	34	24	-07	12	17	15	02	24	19	-03	12	11	-04	02	00	-08	-04	00	-24	-04	-29	-30	-05
12 Rhymes												100	27	29	31	28	37	24	00	35	21	19	-10	06	19	22	-04	29	29	-05	12	08	05	00	04	02	12	00	-14	-05	-25	-28	-21
13 Common Situations													100	55	48	21	25	25	03	35	18	21	-08	08	18	23	00	22	21	-15	10	07	05	02	00	-09	04	-07	-16	00	-13	-17	-07
14 Consequences														100	48	24	23	26	00	30	19	23	00	03	20	20	00	22	23	-15	10	00	05	00	01	00	05	00	-08	09	-13	-19	-16
15 Seeing Problems															100	27	28	30	01	25	13	22	-10	09	21	20	03	22	19	-08	14	01	04	00	04	-04	04	00	-11	07	-19	-22	-16
16 Gestalt Transformation																100	10	22	02	30	24	13	-11	13	17	09	-06	12	13	00	00	14	-05	13	-03	-15	-13	-05	-09	05	-19	-22	18
17 Mutilated Words																	100	26	06	24	19	31	-07	02	08	21	02	24	19	00	05	-03	00	-05	03	04	12	00	-15	-12	-19	-17	-18
18 Dotting Test																		100	08	35	25	26	00	04	03	09	02	21	16	07	21	00	04	-07	12	03	07	08	-16	03	-21	-22	-18
19 Writing X's																			100	00	02	06	00	-04	00	04	03	09	07	06	13	01	04	-07	00	00	02	06	-11	02	-22	04	-06
20 Copying Test																				100	29	27	-09	14	12	11	-04	18	13	00	10	05	00	02	02	05	-04	-07	-14	-12	-16	-26	00
21 Discrimination Reaction Time																					100	18	-10	06	11	00	00	07	11	06	00	-03	-04	-14	02	12	19	00	-16	00	-12	-16	07
22 DAT Clerical Speed and Accuracy																						100	-02	-07	-04	21	04	34	27	00	20	05	00	17	20	08	20	24	24	29	06	-09	-39
23 CTS Anxiety																							100	-35	-11	-16	24	-08	-15	24	18	-05	-05	-02	-05	-16	-24	-13	-15	-12	-06	07	-24
24 Neurotic Emotionality vs. Stability																								100	05	04	00	00	06	-06	-12	19	13	16	-11	04	-10	04	05	-08	-09	-08	12
25 Dominance vs. Submission																									100	14	-07	06	06	-12	-13	08	20	-23	-04	03	19	06	-25	-15	-19	-07	08
26 TSAI Scholastic Motivation																										100	-14	48	44	-10	18	-05	-09	09	22	-05	09	02	03	04	00	-17	-27
27 TSAI Achievement																											100	-14	-18	27	13	03	15	-31	-06	13	19	00	-25	-10	-19	01	-09
28 SSHA Achievement Drive																												100	77	-09	24	-04	11	-33	-13	08	12	-03	-23	-08	-16	-19	-39
29 SSHA Procrastination Orientation																													100	-20	11	02	06	24	40	06	08	07	02	08	07	-18	-29
30 MMAS Autonomy Anxiety																														100	19	04	03	21	39	07	06	06	00	09	02	07	-06
31 MMAS Aggression Anxiety																															100	06	17	-26	29	12	33	14	-11	11	-08	-08	-44
32 MMAS Autonomy																																100	25	28	00	00	00	04	06	-07	01	00	06
33 MMAS Achievement																																	100	08	10	11	-04	09	01	00	00	-01	04
34 MMAS Aggression																																		100	14	-04	-16	05	20	-01	03	00	28
35 MMAS Isolation Anxiety																																			100	07	12	15	03	12	-02	-06	-19
36 Cyclothymia vs. Schizothymia																																				100	33	09	-18	-07	-02	00	-20
37 Premsia vs. Harria																																					100	13	-16	08	-02	-02	-35
38 CTS Criticism of Youth																																						100	35	10	07	07	-09
39 CTS Negative Orientation to Society																																							100	19	14	15	14
40 CTS Social Inadequacy																																								100	07	04	-09
41 Index of Social Status																																									100	92	10
42 Index of Value Orientation																																										100	10
43 Sex-role																																											100

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